City, County and State

MAY 14 1934

PUBLIC WORKS

Sewerage and Sewage Treatment | **Highways and Streets** | **Water Supply Refuse Disposal** | **Construction and Engineering**

MAY, 1934

VOL. 65 PUBLIC WORKS No. 5
Entered as second-class matter at the Post Office at New York, N. Y., Sept. 1, 1922, under the act of March 3, 1879.
Published Monthly by PUBLIC WORKS JOURNAL CORPORATION, 310 East 45th St., New York, N. Y.
SUBSCRIPTION RATES: United States and Possessions, Mexico and Cuba, $3.00. All other countries, $4.00.
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PUBLIC WORKS

Vol. 65 No. 5

CITY, COUNTY AND STATE ENGINEERING AND CONSTRUCTION

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TIME-WASTERS

A good many of the boys have dug out of the snowdrifts and, sniffing the spring air, have sent us solutions and problems galore. But before we begin to acknowledge as many of them as we have space for, we must apologize for the "Not the Water Wheel Problem" which appeared in our March issue. First, the O in the western sector should be D. Second, and more important, it is the "sums of the squares in any two adjacent sectors" and not the "square of the sums." Several people worked it out anyway.

"A Fur Piece," I'll Say:

A commuter always arrived at his home station at 5 P. M. and his wife always met him just as the train stopped, and whisked him home, arriving at exactly the same time every night. But one night the said commuter, taking an earlier train, arrived at his home station at 4 P. M. Since friend wife was not expecting him before the usual time, and was not at the station, he started walking home. At the usual time, f.w. started for the station, met her husband, picked him up, turned about, without loss of time, and arrived at home just 20 minutes earlier than usual. How long had the poor man been walking? Donated by *E. C. Speiden,* Thanks, Mr. Speiden, it's a good one.

The "Killiloo Bird":

A can for holding maple syrup sap is 14 inches in diameter at the top, 9 inches in diameter at the bottom, and 24 inches deep. What amount of sap will it hold when it is tipped so that the liquid just spills over one edge and touches the junction of the opposite side and the bottom. Blame *Don Hastings* for this.

Trisecting an Angle:

Karl F. Kellerman, of the Bureau of Plant Industry, Washington, sends in a solution for the tri-section of an angle graphically, and asks if he has rediscovered a proof already widely known. How many others know how?

Solutions:

Several solutions to the octagon problem, which works out so that R, the radius by which the octagon is laid out is 10.451. There are several ways of doing it, all by means of triangles. The answer to the "fourth of twenty" in the March issue is 7½. The land Ikey bought originally was 144 sq. rods, and he needed 25 sq. rods additional, but bought 145.

Coming:

A tough one from O. J. Semmes, Jr., city engineer of Pensacola, Fla., another about Ikey and Mikey, and a simple one about the crock that went to the river.

W. A. H.

SUBSCRIPTION RATES: United States and Possessions, Mexico and Cuba, $3.00. All other countries, $4.00. Single Copies, 35 cents each.

A. PRESCOTT FOLWELL, *Editor* W. A. HARDENBERGH, *Asso. Editor*

Published monthly by the PUBLIC WORKS JOURNAL CORPORATION, 310 E. 45th St., New York, N. Y. J. T. MORRIS, *President;* W. A. HARDENBERGH, *Vice-Pres.;* CROXTON MORRIS, *Treasurer. Advertising representatives,* S. N. HUME, 310 East 45th St., N. Y.; FRED R. JONES, 100 No. La Salle St., Chicago, Ill.; ALONZO HAWLEY, 1635 E. 25th St., Cleveland, Ohio.

FOUNDED IN 1896

PUBLIC WORKS

City, County and State Engineering and Construction

Vol. 65 — *May, 1934* — No. 5

25% Work Relief Projects— 75%

An Unusual Opportunity for Public Works Construction

WHEREAS, in the CWA, only the desire for employment was necessary, the projects under the Emergency Work Division of the Federal Emergency Relief Administration require that employment be restricted to those in need of relief. This greatly reduces the number of men or women available for work. Also, in the CWA, all labor costs and a small proportion—usually 10% of the total—of the costs for materials and equipment were met by the Federal Government. Under the net set-up, Federal and State funds are provided to meet 75% of the necessary expenditures for labor and materials.

Another essential difference is that, under the new arrangement, wages are set at the prevailing rates—but not less than 30 cents an hour. This removes one of the most frequently voiced objections to the CWA.

An Unusual Opportunity—Save 75%

This provides a most unusual opportunity to carry on many public works projects at a very small cost to the community, since in many cases relief funds will be provided to cover 75% of the total cost. Under this head are sewers, water works construction, highway improvement, mapping, etc.

There are two classifications of work. Urban projects are limited to communities of more than 5,000 population, or to highly industrialized sections which fit this description essentially, though perhaps not legally. Rural projects include village, town or township, water and sewer district, and county projects. Detailed information has been made public regarding projects from urban areas. In general, officials of such communities should deal directly through county Emergency Relief Organizations, and with the State ERA.

Practically no information has been given out regarding the rural projects, yet there is a real opportunity for securing funds for such work.

How to Apply for FERA Funds

The following information is directed particularly toward rural projects, for it is assumed that most urban sections have already been fully informed. Information on either or both will be furnished to our readers on request by letter or telegram.

All rural projects must pass through the county organization that succeeded the CWA—generally known as the Emergency Relief Administration. Until other forms have been received, applications may be made on the CWA form. On page 1 is to be given a brief description of the project with the estimated amount to be supplied by the ERA and the amount (25%) to be contributed locally. On page 2 are the estimated labor costs, including unskilled, semi-skilled, skilled, supervisory and other (which may include engineering supervision). On page 3 the kind of equipment needed and the materials are listed, and other direct costs, followed by a total of all costs. On the 4th and last page are listed the local appropriations or contributions, and information as to the date of beginning work, etc. This application should be signed by the village mayor or president, town supervisor or other local official, and by the county administrator, and forwarded to state ERA headquarters for approval and return. In a recent application for such work, the approved application was returned within a week.

Limits of Money Available

In most states, each county has been awarded a monthly allotment, from which the cost of all projects originating in the county may normally come. If this is adhered to firmly, the amount available to any village or town or township may be small—perhaps less than a thousand dollars a month. Each state is a law unto itself in this regard, and in many cases some extra funds are available for desirable projects.

A newly formed sewer or water district may obtain funds for the construction of water mains, sewer lines, and treatment plants. An existing district may obtain funds for necessary extensions. A village of less than 5,000 population may fall into the same category, and get a water works system or a sewer system and treatment plant for 25% of the total cost. And because of the new regulations on rates of pay, allowing local rates, there need be no more fear that high labor costs will greatly increase the total expenditure necessary.

(Concluded on page 18)

NOT MUCH LEFT FOR ROADS
Courtesy of Concrete Highways and Public Improvements

Canada's Water Works Experienced A Cold Winter

THE winter of 1933-34 will long be remembered by the superintendents of Canada's water works for the troubles caused by the low temperatures. Frozen hydrants, water services and mains were reported from all parts of that country. The mean monthly temperatures at Peterborough, as reported by Ross L. Dobbin, manager of the Public Utilities Commission, were 15.52° in December, 18.87° in January, 3.23° in February and 24.32° in March. Up to April 1st frozen hydrants and services were still being reported in that city. On March 5th 61 calls were received to thaw services—the maximum for the winter. From Feb. 8th to March 31st, 459 water services were thawed.

The methods employed by Mr. Dobbin and others in thawing services and mains and keeping fire hydrants serviceable as reported at the April convention of the Canadian Section of the American Water Works Association, are described briefly below.

In most of the cities thawing is done by electricity. In Peterborough two trucks were rigged up with transformers and cut-outs and both were kept busy from 7 A. M. to 6 P. M. every day, including Sundays, during the coldest weather. One outfit used two 10 kw. transformers, connected 2,200-110-55 volts; the other used two 25 kva transformers connected the same way. A foreman, two linesmen, a ground man and a truck driver accompanied each outfit. The maximum number of thaws in 10 hrs. with one outfit was 28, two thaws being made with one hook-up in some cases; but with thaws scattered all over the city, 20 a day for both trucks was a good record. Most of the time was consumed in moving and connecting to the primary wires; the current was on only two or three minutes in most cases. Three dead-end mains, one 6" and two 4", were thawed in three hours each, using 50 kva.

Lead service pipes took longer to thaw than iron; and in the case of mains, the presence of leadite joints increased the time required. In thawing a 6-in. main, a leadite joint was perforated and sulphuretted hydrogen was generated from the leadite, absorbed by the water in the main and delivered into the neighboring residences. In some cases a leather washer had been used in making up a flanged joint at the curb cock or meter, and these were burned by the current, causing leaks.

After a service or main had been thawed, it was allowed to run continuously until the frost had left the soil around it. In March there were about 600 services running continuously in Peterborough, using an extra 900,000 gal. of water per day. Kirkland Lake encourages the consumers to leave taps running during cold weather as the only way to prevent freezing.

In thawing services by electricity, the electrical ground should be removed, or fire or other damage may result. In one case a woman had her hand burned by hot water coming from a cold water faucet when electric thawing was taking place in another house. Ottawa uses a thawing outfit which is entirely insulated from the ground which reduces the fire risk.

Hydrants were thawed out in Peterborough with hot water and salt and then pumped out. "By running a barrel of hot water into the hydrant and out of the drip at the bottom we were able to keep these hydrants from freezing for a day or two. We found that we had to keep it up with the majority of them every two days." That city tried, late in March, a small steam thawer using kerosene as fuel. It removed the ice from the barrel but Mr. Dobbin does "not think its effect is as lasting as a large quantity of very hot water soaked into the surrounding soil."

Kirkland Lake inspected all its hydrants every morning and by ten o'clock reported to the fire department any that were frozen.

Peterborough found that where valves had been set in chambers, the bonnets of some of them filled with ice and the valve stems could not be turned until they had been thawed out with hot water and steam.

The cost in Peterborough of thawing 459 services by electricity was $1,097.79 for labor, or $2.39 per service, not including any charge for equipment, or for the power used. The extra labor cost of taking care of the 325 fire hydrants was about $300 (not including the regular inspection) and eighteen bags of salt were used.

In Ottawa, according to W. E. Macdonald, city water works engineer, "practically all gate valves in the entire distribution system had to receive an application of steam before same could be operated." Check valves, used for separating the high service from the other, were all wrapped with mineral wool covered with 3" tape, and the same precautions were taken with air valves on the high pressure line and in most cases electric heaters were installed in these chambers as an added precaution. Blow-offs on all dead-ends were kept open to provide circulation to keep the mains from freezing.

For thawing out hydrants and thawing mains and services when the city's five electrical machines were unable to attend to them all, the city used six steam boilers mounted on trucks. Experienced hydrant inspectors make daily inspections of the fire hydrants and report immediately to the central office any hydrant out of order. The steam boilers are kept ready during the whole 24 hours to thaw hydrants. They respond to all fire calls, and immediately on arrival the boiler man checks up on all hydrants likely to be used, and then tests those in the outlying area if the fire looks in the least serious. He also assists the firemen when possible, as by thawing hose connections.

As a precaution when mains were found to be freezing, hydrants in the business area were blown off after midnight and allowed to run full stream for 15 minutes, thus breaking the ice forming in the mains.

Services and mains in Peterborough froze at depths as great as 7 ft. in gravel under pavements from which the snow had been removed. In sand or clay 5 ft. was probably the maximum. Pipes near catch basins were especially subject to freezing.

In Ottawa, frost went as low as 8 ft. in some soils, but some mains which were laid inside the sidewalk where the snow was not removed, were safe with less covering. In the future, mains will be laid on the sides of business streets, where the roadways are kept clear of snow. Frost under 4 feet of snow was found to have penetrated only 18 in., although it was 6 ft. deep under a cleared roadway a few feet distant.

Building Sewers Under Difficult Conditions*

Much interest was aroused at a recent meeting of the New York State Sewage Works Assn. by Mr. Ziegler's discussion of this troublesome problem. Some excerpts from his address follow.

By F. C. Zeigler

Project Engineer, Westchester County Sanitary Sewer Commission

Construction in Wet Soils

ONE of the most important of the troubles to be encountered in sewer and appurtenant construction is the proper control of subsurface water conditions; also the proper handling of materials to be excavated to secure a firm, undisturbed subgrade without loss or shifting of adjacent ground. The construction of large and deep trunk sewers usually involves far greater difficulties than small ones, yet the skilled sewer contractor appears to manage both with ease.

Tight and substantial trench sheeting, firmly braced, driven well below subgrade in a workmanlike manner with air hammers, backfilling of cavities outside of the sheeting, and storing excavated material far enough away from the edge of the trench to avoid surcharge pressure are necessary, of course, in difficult or deep ground conditions, especially where adjacent to pavements, buildings, tracks or other structures.

Soft trench bottoms may often be made firm by removing some or all of the poor subgrade material and replacing it with broken stone, gravel or tamped cinders. In boiling, water-laden, shifting materials, a mat of hay placed in the bottom before the broken stone will usually be effective in eliminating troublesome conditions. Good pumps of the centrifugal type operating from deep sumps to which the underdrain is led, placed at reasonably close intervals, are most commonly used for trench drainage. When necessary to avoid deposits or turbidity in streams or drains, the well point system in favorable soils will usually be more satisfactory than pumps. However, pumping into properly designed and maintained settling boxes with suitable overflows may otherwise reduce objectionable deposits.

Crawler pull shovels and convertible cranes with clam-shell buckets for trench excavating and drag line buckets and bulldozers for backfilling in the presence of puddling are commonly used on large sewer work.

The circular type sewer, where of reinforced concrete, may be of monolithic construction or pre-cast pipe laid on a poured concrete cradle. Some contractors seem to be of the opinion that monolithic work is less costly than the pre-cast type. The majority appear in favor of pre-cast pipe construction if for no other advantage than speed in laying. Joint making, however, requires skilled and experienced workmen if trouble is to be avoided in testing or otherwise.

Tunneling

Tunnel construction requires expert planning and execution. Size of the tunnel and character of material encountered greatly affect the methods to be used and the ultimate cost. In small tunnels, practically all work must be done by hand. Larger tunnels permit use of track and machinery. Rock work with its blasting often involves risk of damage to buildings and other property. In cities, blasting may be restricted by ordinance to daytime working hours, so that progress may be slow and expensive. Tunneling in soft or flowing and shifting material may require perhaps the use of compressed air for its successful execution. The use of steel liner plates is usually very satisfactory for temporarily restraining soft or non-self-supporting material in tunnel excavation. Where heavy or moving loads are overhead, these lines have been reinforced with alternating steel I-beam ribs.

Tunnel portals and shafts with their equipment and noisy operation are often a nuisance over an extended period of time and a source of many complaints in a populated community. Under such conditions, the use of silent equipment and reduction of all noise to a minimum is necessary.

Suitable headframes, cages, cars, trucks, hoisting and material handling equipment are essential to economical prosecution of the work. Facilities for good ventilation and drainage should be provided as well as good electric lighting. These three are especially important to the engineer in his line and grade work. In short tunnels electric lights may be supplied by means of portable generators.

Alignment holes may be driven vertically from the surface of the ground to the tunnel level at convenient places for establishing or checking line and grade in long tunnels or ones of irregular alignment.

Concrete for lining tunnels of small diameter may be deposited by hand or placed by chuting through bore holes previously driven from the ground surface. In larger tunnels, rapid progress may be made by conveying the concrete in cars from a shaft or portal mixing plant to a chuting machine set up on a movable carriage just outside of the forms to be concreted. The central mixing plant, so arranged as to reduce to a minimum the handling of materials and with features permitting close regulation and uniformity of output, lends itself to most satisfactory and economical work. Transit-mixed concrete, properly controlled and inspected at all stages, is an excellent product provided it can be delivered as and when desired without delay. In fact, care in designing concrete by analyzing and selection of materials and their proportioning will produce very gratifying results in strength and quality.

Jacking Pipe

Jacking pre-cast concrete pipes in material other than rock under roads and railroads is somewhat successful under suitable conditions. Favorable use of the jacking process usually occurs with small diameter pipe and through short distances.

Among the essentials which are necessary to success in jacking pipe may be mentioned a few, such as careful planning and preparation of all details of the work, definite advance information as to subsurface soil conditions at pipe grade; use of extra-strength reinforced concrete pipe of the A.S.T.M. Designation C76-30T, usually 4750 lb. quality; absolute drainage of water

*Excerpt from a paper before the New York State Sewage Works Association.

to a level below grade; dependable jacks, in duplicate, of ample power, tested in advance; experienced workmen and superintendent; as well as complete equipment necessary for continuous operation. With large pipes, the use of a steel shield, a part of which controls its direction by means of screws, at the advance end of the work appears to have been the most successful method used to maintain true line and grade throughout the jacking operation.

Pipes which are jacked may be used to envelop a smaller enclosed pipe sewer. Otherwise, if used for the sewer itself, special attention should be given to tightly seal all joints as well as to grout them to prevent infiltration or leakage.

Tightness of Sewers

In another paper dealing with watertightness in sewers, E. C. Hallock, Chief Inspector, gave the following as the Commission's requirements as to tightness:

The Commission's specifications require that a water or air pressure test of at least 40 pounds per square inch shall be applied for 24 hours to the interior of cast-iron gravity or pressure sewers, and all joints which leak under such test shall be recaulked or otherwise repaired even to the extent of melting the joint and repouring and caulking until tight. In making the water test, the trench and bell holes shall be kept free of water.

The Commission's specifications for testing reinforced concrete pipe for watertightness provide that "The sewer barrel shall be filled with water, which shall then be brought to a pressure equivalent to a height, upon completion of the test, of no less than 4 feet above the exterior crown of the sewer at the upstream end of each section tested. When making a test with water inside of the sewer, all water shall be excluded from the trench.

"Leakage from inside or infiltration from outside the concrete pipe sewer during a continuous 24-hour test shall not exceed a rate of 1 gallon per hour per inch of inner diameter of pipe per 100 feet of completed sewer, and no joint or 8-foot length of pipe in completed sewer shall leak an amount in excess of 1 quart per hour per inch of inner diameter."

In the case of the Mamaroneck trunk line sewers, the total infiltration allowed was over 725,000 gallons for 24 hours, for about 15 miles, while the actual infiltration showed a maximum of 86,000 gallons for 24 hours.

Revision of Reinforced Concrete Pipe Specifications

At the 1934 spring group meetings of committees of the A. S. T. M., Committee C-13 on concrete pipe, it was decided to revise the specifications for reinforced concrete pipe, particularly as follows:

The tabulation of strength requirements has been materially increased for all sizes of pipe. For example, in Table I, strength requirements for 24-in. diameter pipe under loads to produce a 0.01-in. crack, have been increased from 1740 lb. per lin. ft. to 2400 lb. and for 36-in. from 2470 to 3000 lb.; and under "Minimum Design Requirements" concrete of 3000 lb., 4500 lb. and 5000 lb. per sq. in. will replace the old values respectively of 2750 lb., 4000 lb. and 4500 lb.

All sizes above 24-inch are assumed to be reinforced.

Similar increases in load and "Minimum Design Requirements" have been worked out for extra strength pipe.

The work on revision of concrete culvert pipe specifications has made considerable progress, but has not yet reached the stage for action by the full committee. The committee is planning to proceed with the preparation of a brief manual of laying practice covering both culvert and sewer pipe for publication as an appendix to the specifications.

Interesting Features of Upper Darby Highway Report

1. It reached this office within a few days of the close of the year which it covered.

2. "The maintenance of our township highways is a continuous problem which cannot be solved by giving our roads a double amount of attention next year or the year after to compensate for what we neglect doing this year. A road pitted with small holes today will be almost impassable within a few weeks. As deterioration is cumulative, street repairs cannot be postponed." Opening its annual report with the above statement, the Highway Committee of Upper Darby Township, Pa. (Samuel H. Walker, chairman, John T. Brosnan and James F. Connor), tells how it managed to preserve its highways from deterioration, in spite of "terrific pressure from all sides to reduce expenditures." Of its 900,000 sq. yd. of bituminous macadam, 90,000 required repairs, of which about 45,000 called for complete resurfacing, but financial limitations made this impossible in 1933. Instead, 12,165 yards were resurfaced, and 69,000 were given a surface treatment at an average cost of 5.6 cents per square yard, which has proved even more satisfactory than was expected. (See PUBLIC WORKS for September). The resurfacing cost 57 cents per square yard by contract.

3. CWA work began December 1 with 100 men, who were put to work (with equipment and supervision furnished by the Highway Department) building roads, grading, and constructing wading pool, tennis courts, and parking places in the Township Park.

4. In making temporary repairs in an almost impassable street "The holes were filled and levelled with excess bituminous material removed during the resurfacing of Shadel and Maple Avenues. Rolling with a ten-ton roller bound this material together and the intersections were surfaced with cold patch. These repairs were quite inexpensive and the road is now in such condition that it may be used by heavy traffic."

5. Sidewalks were built by the township along a few roads where there were no residences. One of these is used by children going to and from two of the schools, and here the owner dedicated to the town a strip 13.7 ft. wide and 631 ft. long. The existing hedge was moved back to the new property line and a cement sidewalk 5 ft. wide constructed along the entire length. In building these sidewalks the town used concrete contracted for at $6.30 a cubic yard, mixed at a central plant and delivered in agitating trucks.

Read the instructions and warnings found in every box of dynamite

Handling and Using Explosives

High explosives are being used widely in connection with various Federal aid projects and in the CCC camps, and in much of this work the handling and use of them are under the direction of men who have had little if any experience with them. An expert knowledge of the use of explosives is not necessary, but there is a present need for a working knowledge of certain simple and essential precautions to prevent the possibility of accidents.

Important Facts to Bear in Mind

NO explosives should ever be stored in or near a house or other structure occupied as living quarters. If a fire should occur they would be pretty certain to blow up. Blasting caps should never be kept in a house or carried in a pocket, or left where children can find them. Serious injury may result from use of them as playthings.

Dynamite should never be stored in a hot place. A high temperature is likely to cause the waterproofing of the fuse to seep into the powder core and cause a misfire.

Dynamite and blasting caps should never be kept anywhere near together; caps are much more sensitive to sparks and rough handling than is dynamite, and if the caps explode they are liable to set off the dynamite.

Smoking while handling explosives is foolhardy. Dynamite may burn peacefully when set on fire, but then again it may explode. Caps invariably explode when lighted matches or hot pipe, cigarette or cigar ashes drop on them. It should be a fixed rule to keep packages of explosives or blasting caps covered as a protection against sparks.

After a shot has been loaded, the unused dynamite or other explosives and the remaining blasting caps should be removed to a safe distance. While the blaster may be cautious enough not to smoke or throw lighted matches about, the sparks from the burning fuse may, and often have, set off boxes of caps with disastrous results.

A crimper of approved type is the only tool that should be used for crimping blasting caps to fuse. Use of a knife blade or the teeth is neither safe or effective. Men have had their jaws torn away by explosions of blasting caps when trying to crimp them with the teeth; and the use of knife blades and other make-shift tools for crimping have meant the loss of hands, eyesight and other injuries.

How to Use the Fuse

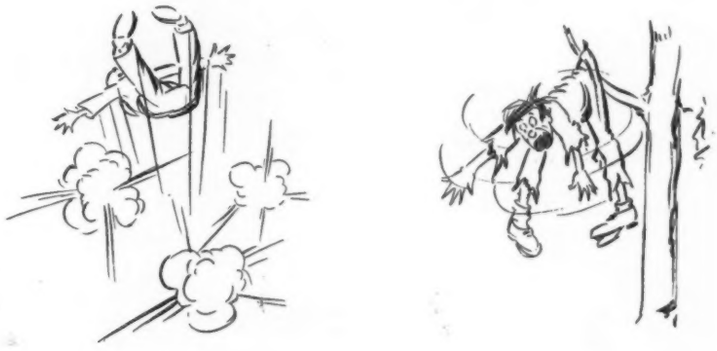
Short fuse can be a source of danger to a blaster. Cut fuse sufficiently long to extend beyond the collar of the hole, and long enough to allow plenty of time to retire a safe distance from the blast. Fuse should be cut square across, not on a slant. An inch or two of fuse should be cut off to insure having a fresh end to insert in the blasting cap.

It is quite a trick to light a fuse successfully. The best way is to hold the head of a safety match against the exposed powder core of the fuse and scratch the side of the match box against the head of the match. Another effective method is to slit the fuse a little more than half way through for about an inch from the end, open it up and put the match, while the head is still flaming, into the powder.

Never attempt to light a fuse by holding burning paper or leaves or other bonfire material under it; you may light the fuse but you never can tell whether or not you have, and you may become the victim of the explosion when attempting to investigate.

A supposed misfire too often proves to be a hang-

If you do this



Something like this, only worse, may happen

fire. Don't attempt to investigate a misfire too soon, even if it is thought the fuse has not been lighted or has gone out.

Tamping the Charge

Danger also lurks in neglect to use sufficient stemming in a loaded hole to protect the explosive charge from sparks from the burning fuse. (Stemming is the earth or other inert material which is packed or tamped in a bore hole on top of explosives.) Tamping should be done carefully, not only to properly confine the gases of the explosion and thereby get the full effect of the blast, but also to provide against openings in the stemming through which sparks from the fuse might drop and cause a premature explosion.

For loading and tamping, only a wooden tamping stick should be used. For shallow work, an old broom handle or a straight shovel handle is suitable. For deep holes, where a long stick is needed, a straight sapling can be used to advantage. *Never, under any circumstance, use anything made of metal* for loading or tamping a bore hole; the danger of a spark from contact with rock is too great to risk. Only enough force to seat dynamite cartridges should be applied in loading.

In blasting by the electrical method, which involves the use of electric blasting caps and a blasting machine, additional precautions applicable to such method should be taken, information concerning which may be obtained from makers of explosives.

When in Doubt—Don't

To do blasting safely, economically and efficiently, the blaster must know what he is doing, and when in doubt, don't do it.

Read the instructions found in every dynamite box and follow them!

"Safety in the Handling and Use of Explosives"—a complete booklet on this subject—will be sent without charge on request to the Editor of *Public Works*.

Chanute's Utilities Run the City

"Chanute has achieved success in municipal operation of utilities to an extent that the electric, gas and water plants have shouldered the entire city tax load of the property owners." So begins the annual report for 1933 of City Clerk Ross Cooper. "Since the first taxless budget was adopted, in the summer of 1930, not one cent of property taxes has been levied by the board of city commissioners." In 1925 and 1926 the city tax rate was $1.381. The citizens still pay school, county and state taxes, which totaled $2.5728 per $100 valuation in 1933.

Not only do the utilities' earnings pay the city costs, but the rates are considered low. For gas, per M cubic feet, the rate is 45c. for the first 10,000; 40c. for the next 10,000; 35c. for the next 80,000, and 30c. for all beyond. For water, the rates per hundred cubic feet are: 25c. for the first 1,200; 17.5c. to 12,000; 12.5c. to 120,000; 10c. to 1,200,000; 9c. to 12,000,000; and 8c. for all beyond. For electricity, the lighting rates per kwh are: 6c. for the first 50; 5c. for the next 50; 4c. for all over 100 kwh. Minimum charge for each utility, 50c. a month.

Chanute (which was named for the civil engineer Octave Chanute) installed its water system in 1894; purchased its gas system from a private company in 1899, and in 1903 installed an electric generating and distributing system using $32,000 from the gas department. These plants today represent an investment of $1,304,929, free from debt except for $120,000 bonds against the water plant, which are being retired at the rate of $16,000 a year.

Chanute's municipal light and water plants

Water is taken from the river, filtered and pumped to an elevated tank. Natural gas is purchased by the city at an average price of 18c per M. cu. ft. The electric plant is operated by gas, with oil in reserve for an emergency. Steam turbine type generating equipment is used.

In 1933 the receipts from sale of gas were $103,022; from sale of water, $41,704; and from sale of electricity, $134,337. The operating expenses were: gas, $54,955; water, $22,758; electric, $74,345. These include insurance and allowance for bad debts.

The gas and electric departments have reserve funds set aside for major improvements that become necessary. The gas department reserve amounts to $10,000 and the electric plant reserve now is $55,246.84.

Plant-Mixed Tar Concrete Laid in Winter

AN example of winter work to afford employment is offered by the paving of Glenside Avenue, near Summit, N. J., for the Highway Department of Union County, in which a tar-bound macadam foundation and a "Tarvia-lithic" (plant-mixed tar concrete) top was used. Before the work was started, Glenside Avenue was a narrow, crooked road with steep grades. Some surfacing material had been placed on it so that it was passable but could not be considered a very satisfactory highway.

It was decided to widen the road to a paved width of 20 feet. The grading was done by unemployed labor working in gangs. While all the work possible was done by hand, machinery was utilized where it was considered necessary to use it. Drainage structures were installed where needed. The side slopes of the road were cleared, trimmed up and shaped at the same time. The subgrade was now ready for the macadam foundation.

A 6-inch macadam base was built according to standard methods. Stone was purchased from local quarries and hauled to the job in county trucks. It was spread over the subgrade to the required depth from the dump trucks. Final spreading was accomplished by a gang of unemployed labor. One or more experienced road builders, recruited from the regular county road-building forces, were included in each gang to instruct and assist the inexperienced men.

The loose stone was then thoroughly rolled and filled with stone screenings.

Because of the necessity for working under winter weather conditions, it was deemed not advisable to use water and build the ordinary water-bound macadam foundation. In place of the water, a cold refined tar was used. This material had a specific viscosity at 40°C. of 8 to 13 and was purchased from The Barrett Company, being their material "Tarvia B." This cold tar was applied by means of a pressure distributor at the rate of ½ to ¾ gallons per square yard. It penetrated into the macadam surface to the depth of an inch or more and thoroughly bound the particles of stone together. It also waterproofed the top of the foundation.

The selection of the wearing surface was the next problem. The material must be one which would be available at all times and one which could be handled throughout a normal New Jersey winter. This meant that some work might have to be done soon after snow storms with the temperature at freezing, or below.

The decision was made to use a tar coated, pre-mixed stone called "Tarvia-lithic," produced at a central mixing plant at Bound Brook, New Jersey.

Dumping and spreading plant mix hauled twenty miles

The wearing course was placed in two layers, first a 2-inch layer of intermediate size Tarvia-lithic made of stone averaging about 1 in. in diameter. The material was hauled about 20 miles in county dump trucks. Canvas covers were used on the trucks to retain the heat in the mixture. Shovels, rakes and other tools were heated in a portable heater.

In some instances it was necessary to use surface heaters to dry the surface before the wearing course was laid. At one or more times the wearing course was laid after snow had been shoveled from the foundation.

The intermediate layer was thoroughly rolled before the top course was added. This top course was made up of tar-coated chips and was spread over the intermediates to the depth of about an inch. Great care was taken to level off the surface so as to obtain an easy-riding road. This work was done by unemployed labor with satisfactory results. Some of the men were not accustomed to manual labor and were slow at the start but soon toughened and were able to keep up with the gang. Keeping a certain number of experienced county men with each gang set the pace and produced excellent results for this class of unskilled labor.

The top layer of Tarvia-lithic fines, approximately 1-inch thick was rolled to a solid, even surface and the road was then thrown open to traffic.

Drying and Incineration of Sewage Sludge

By Alden E. Stilson, Assoc. M. Am. Soc. C. E.
Sanitary Engineer, Morse-Boulger Co.

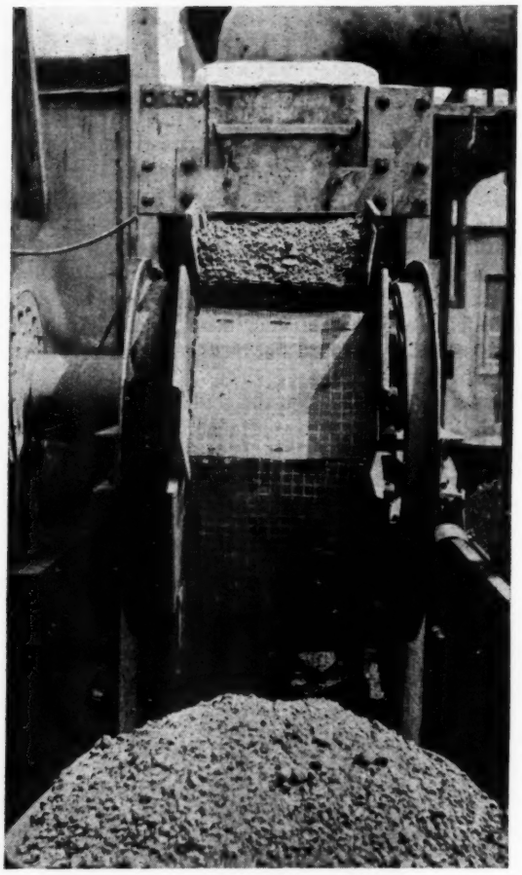
THE drying and incineration of sewage sludge as the final steps in sewage disposal offer sufficient attraction and possibilities to warrant considerable study on the part of interested engineers and public works officials. It is hoped that the following outline of thought may give some useful ideas to these men.

Successful and economical sludge incineration seems to necessitate three distinct steps; First—dewatering to a concentrated filter cake; second—drying of the cake to prepare the sludge for mechanically firing; third—complete combustion of the material.

Various types of filters are at present completing the first step satisfactorily. The value of filtration is readily demonstrated. When one ton of settled solids comes to a filter, it may very possibly be mixed with 19 tons of water. Filters with the aid of chemical conditioners may be counted upon to reduce this water content to 3 tons. Assuming that to evaporate and incinerate without odor or smoke, it is necessary to maintain a temperature of at least 1250° F in the incinerator, then, by removing 9 to 16 or more tons of water the filter has saved from 280 to 500 gallons of fuel oil or equivalent fuel values.

The second step—evaporating the major portion of the remaining water—is likewise very important. Normally there is fuel value in the dry solids which will supply nearly all the heat necessary to evaporate the three tons of water in the filter cake if the solids can be made to give up their heat. The problem is to make them into a useful fuel without undue expense and obnoxious odors. This second step of evaporating filter cake down to a combustible moisture content has been accomplished in a high temperature, direct fired, rotary kiln, but the attending odor has been a problem. Efforts have been made to wash the odor from the dryer exhaust. The odors may be burned off, it is said, with good results at 700° F.

Recently a dryer of different design using large quantities of low-temperature air has been tried out. This dryer moves the sludge rapidly through the warm air drying zone without agitating the bed, which is thin and porous, or raising its temperature above 120° F. The unit delivers a continuous stream of dried material but does not permit any particle of sludge to remain in process more than 15 or 20 minutes, as compared with some 80 to 90 minutes of treatment given a unit of sludge in the rotary high-temperature type dryer. Originally the low-temperature non-agitating type of dryer was used for processing salt, coal and ore. It is sturdy but easily and quickly controlled under all normal conditions.



Dryer of the type shown in the schematic layout

Several large cities have carefully considered incineration. At least one city is now experimenting with an ingenious mechanical dryer which dries and pulverizes the material preparatory to using the sludge as a fuel in the drying process. Another large city seriously contemplates the incineration of its chemically treated sludge. It is hoped that definite data will soon be made public from these two cities.

Probably the first thing to examine is the odor problem which, if solved successfully, makes the other problems in the drying step comparatively simple.

*Data for Study**

Quantity .....One million gallons
Character .....Fresh sewage, not seeded
Total suspended solids .....250 parts per million
Solids removed .....2000 pounds
Temperature as received .....55° F.

Treatment and Results

Time of digestion—200 days for complete digestion (not necessarily plant practice but merely for discussion purposes).
Temperature of digestion—82° F.
Condition of digested residue—stable.
Weight of digested dry solids—1176 pounds.
Weight of ash after ignition—400 pounds.
Weight of combustible in residual solids by difference—776 pounds.
Weight of solids lost during digestion—824 pounds

*While not all of these data, treatment and results are those found in common practice, they are representative of what might be attained by a plant operating under theoretically perfect conditions.

Analysis of Ash Free Dry Volatiles Before Digestion

Total carbon 43%	688	pounds
Total nitrogen 2.5%	40	pounds
Fats, oils, grease 54.5%	872	pounds

Analysis of Ash Free Dry Volatiles After Digestion

Fixed carbon 60.9%	472	pounds
Fixed nitrogen 4.1%	32	pounds
Fixed fats, oils, grease 35%	272	pounds

Subtracting the weights of materials found in the combustible solids after digestion from the weights of materials found in the combustible solids as received in the fresh sewage, the following analysis of the material in the digestible solids may be made by difference.

Volatile carbon 26.25%	216	pounds
Volatile nitrogen ..... .98%	8	pounds
Volatile fats, oils, grease..... 72.77%	600	pounds

Discussion

Apparently 69% of all the fats, oils and grease, comprising 54.5% of all the combustible material in domestic sewage, is digestible. Likewise, only 31% to 32% of the proteins or albumens, comprising 43% of the combustible in a typical domestic sewage, is sufficiently complex from a chemical standpoint to be digested.

As a test of the character of the fats, oils and grease in sewage, saponification is a good indicator. Vegetable and animal fats, oils and grease have high saponification numbers, whereas only the best of mineral oils go as high as number 20. A saponification test will show that nearly 76% of the fats, oils and grease in ordinary domestic wastes will re-act.

This rough means of checking agrees quite closely with the analysis used. For the purpose of discussion, it will therefore be assumed that the 600 pounds of oils, fats, and grease found to be digestible and representing nearly 73% of all the low-temperature volatiles, are of vegetable or animal origin. Unless a substance is gasified, its odor is not discernible, therefore it may be assumed that 73% of the odor from rapidly dried fresh sludge may be due to these vegetable or animal fats, oils and greases.

If odor during drying is to be overcome, the predominating glycerols produced through a breakdown of these vegetable and organic fats, oils and greases must be studied before means of drying without breakdown can be found.

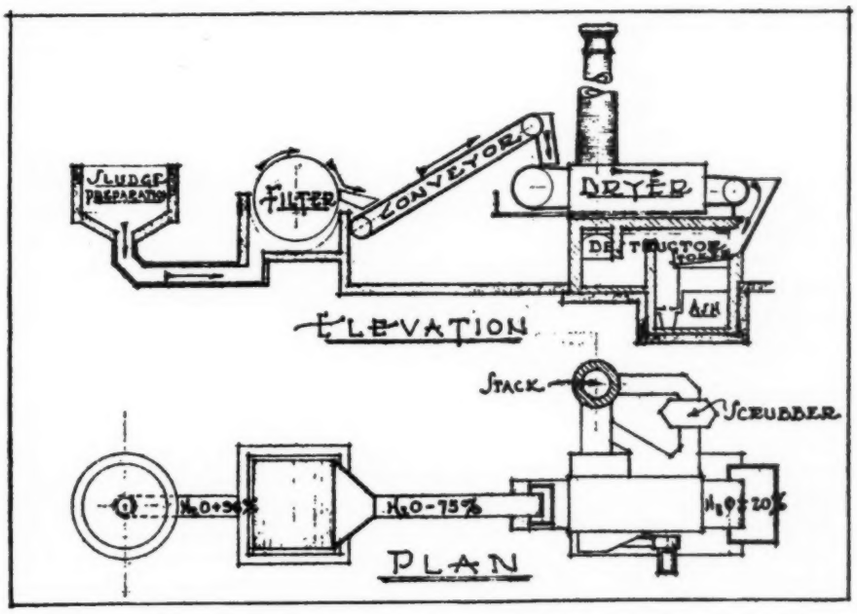
Chevreul in 1815 described vegetable oils, fats and greases as being non-volatile compounds of fatty acids with glycerol forming glycerides. In fresh sewage the principal glycerides are stearin, palmetin, olein, butyrin, caproin, caprylin and caprin. It is very significant that glycerides are said to be non-volatile as long as they are not allowed to decompose and form their respective acids, which are odorous.

Urine and feces in fresh sewage are a source of odor due to their residual fatty acid content. The chemistry of organic materials indicates that this odor can be substantially eliminated before sedimentation by the use of calcium carbonate and lime. The calcium salts of the acids are quickly formed to destroy the source of original odors, and the released carbonate acts to arrest and neutralize the formation of additional free acid or the acids in the excess of calcium for combination. It is believed that the amount of calcium carbonate and lime required to make the sewage but slightly alkaline is sufficient in most cases where incineration of the sludge is to follow.

Pasteurization is a common means of killing bacteria. In this process a temperature ranging from 135° F. to 140° F. is most effective. It is indicated that sludge digests best between 80° and 95° F. and that the speed of digestion is reduced in the range 95° to about 125° F. Above 125° thermophylic bacteria take up the work, but the fact remains that in the range 95° to 125°, odor due to breakdown from bacteria is produced more slowly than either below or above this temperature range.

A very serious source of odor in the high temperature drying operations so far undertaken has been scorching of fats to form acrid vapors. It is known that practically all fats, oils or greases are liquid at body temperature or about 98.6° F. By definition a liquid is a substance able to flow and so capable of reaching quickly the surface of the sludge cake particles and/or the lowest portion or hot shell of a direct-fired rotating dryer if it is the containing vessel. It is to be again remembered that the glycerides are non-volatile and therefore must be physically disassociated, as by boiling, before they become odorous. Furthermore, it is reasonable to suppose that a non-volatile has not been scorched so long as it is below its point of appreciable volatilty, which for the purpose of this work has been considered to be in the range of the boiling points.

Since the fatty acid boiling points are all above 125° F. and since the boiling points of the glycerides are all respectively higher, it is a reasonable



Schematic layout of sludge drying and incinerating plant

assumption that neither the glycerides themselves nor any calcium salts formed by their acids will scorch at temperatures below 125° F.

The boiling points of the principal fatty acids are

Lactic Acid	252° F. @	15 mm.
Stearic acid	722° F.	
Oleic acid	547° F. @	100 mm.
Palmitic acid	419° F. @	15 mm.
Butyric acid	326° F.	
Acrylic acid	287° F.	
Acrolein	126.5° F.	

It is significant that 722° F. is among the highest boiling points of the glycerides common to sewage solids. An oil vaporized by boiling is in a perfect condition to be burned. Its latent heat of vaporization has been satisfied, it is in possession of a certain degree of sensible heat, it is entirely surrounded by the oxygen in the air if boiling takes place at atmospheric pressure as in a dryer. Logically, if this vaporized oil be brought in contact with sufficient temperature, scorching will take place and acrid smoke result unless complete combustion occurs.

To summarize the drying steps from the standpoint of the fats, which are assumed to be 73% of the odor problem—

1. The sludge should be slightly alkaline.
2. The free moisture should be eliminated quickly and evenly to a uniform average in the finished material of about 20%* .
3. The further production of odors from bacterial activity should be stopped by drying the material at a temperature in the material of between 95° and 125° F., in which range of temperature their activity is retarded.
4. The temperature of the sludge should be kept below 125° F., and the sludge kept away from highly heated surfaces to prevent scorching or fire and the attendant odor.
5. The air exhausted during the drying of the sludge from about 50% moisture on down should be passed through a zone hotter than 722° F. NOTE: A temperature of 700° in a hot zone has been found to be sufficient to burn the odors produced from scorching material in the high-temperature rotary dryers. (Laboratory work by others indicates that 1250° F. may be necessary.)

The other major source of odor in sludge is in the proteins and albumens, amounting to about 26% of the volatile that is assumed to be digested out. Fatty acids have the general and comparatively simple formula $C_n H_{2n} O_2$, whereas the proteins as a group have the highly complex general analysis in parts per hundred C_{50-55}, $H_{6.9-7.3}$, N_{15-19}, O_{19-24}, $S_{0.3-2.4}$. Bacteria break down this structure very readily. The first parts to be lost are hydrogen and sulphur. Anaerobic bacteria are a principal enemy of proteins. If drying is done in the presence of air in excess and at or above 95° F., this group of bacteria remain practically dormant. It is noteworthy that troubles from sulphurous odors are not encountered unless decomposition has commenced. If the incoming sewage contains H_2S, the work at Los Angeles and Newark, N. Y., and in New Jersey has shown that chlorine is a good antidote. Ferric chloride as a conditioner for filtration should effectually insure against further difficulties from this source in the filter cake if drying and incineration are to follow immediately afterward.

The fact that both ethyl and methyl alcohols evaporate at low temperature makes it nearly impossible for mercaptans to be formed in the process of drying. The volatilization point of sulphur ranges from about 252° F. upward, which means that the alcohols of formation have long since disappeared. The critical points from the standpoint of volatility of the various acids derived from protein decomposition are thought to be:

Succinic acid	454.5° F. Boiling point
Racemic acid	399° F. Melting point
Ethyldisulphide	304° F. Boiling point
Uric acid	680° F. Decomposes
Malic acid	276° F. Melting point
Phosphoric acid	101.5° MP and loses ½ H_2O at 415° F.
Carbon disulphide	115.2 Boiling point
Ethyl mercaptan	94.4 Boiling point

This study of proteins brings to light certain requirements which must be considered in dryer design to prevent possible odors from this source during operation. These may be summarized as follows:

1. The sludge should be treated with chemicals before filtration if sulphur odors emanate from it.
2. The weight of air used for drying should be from 200 to 500 times the weight of the solids to be dried.
3. The temperature of the drying solids should be held below 100° F.
4. All air taken out of the portions of the dryer in which the material is above 100° F. should be heated to at least 700° F. to oxidize any sulphur compounds or other combustible gases.
5. The materials from the dryer should immediately be chilled below 94.4° F. to prevent distillation of any odorous substance after it leaves the dryer by reason of residual heat in the solids.
6. The materials from the dryer should immediately be burned in an incinerator or in other ways kept from self-combustion, which is a serious danger when storing alcohol-forming and greasy substances in the possible presence of bacteria as is the case with sludge.

Of the three classes of odor or gas producing materials volatilized during drying operations, the nitrogenous is less than one percent. If nitrogenous (particularly ammoniacal) compounds are produced at all in the drying of the sludge, the resulting odor can be theoretically eliminated by scrubbing with water since they seem to be water soluble.

(The conclusion of this article, dealing with incineration of dried material, and discussions by others, will appear in the June issue. Discussions are invited from any interested readers.)

*Experiment shows and recent work by Rudolfs indicates that very little scorching takes place when the average moisture content is above 20%. Manufacturers of modern pulverizers and stoker equipment state that a 20% moisture average in the material will not interfere with the successful handling of the substance.

Gas in Sewer Kills Two

Deaths of two sewer department employes at Lorain, Ohio, on Tuesday, March 13, while flushing out a deep pit under a manhole, almost duplicated conditions at Lima, two years ago last Fall, when Earl I. Roberts, supervising engineer, lost his life in a futile effort to save that of a sewer workman. One of the victims entered a manhole, hose in hand, for the purpose of flushing out a 40-ft. pit, and had partly finished his task and almost reached the top of the ladder on his way to the surface when, overcome by gas, he lost his hold and fell back to the bottom. One of his companions immediately went down after him, ignoring the protest of a third workman, who hastened to call the fire department, with both rescue and resuscitating equipment. The department answered the call promptly, but arrived too late to save either the first victim or his would-be rescuer.

The Editor's Page

Common Sense and Highway Revenue Diversions

Gasoline taxes have been collected with so little protest from motorists, most of whom appreciate the need for an adequate highway system and its value to them, that many of our states, seeing how easily they can be obtained, have indulged in a real orgy of grabbing such funds for all sorts of purposes, aside from road-building. Now Congress is asking very pertinently "why should states divert state road money to other uses and then expect to receive federal road funds?"

If a provision were written into the legislation which authorizes federal aid for highways, providing that federal funds be denied those states that divert gasoline taxes and motor license revenues to non-highway purpose, it would be a wholesome and sound step. The funds so raised should be applied to but one purpose—the construction and maintenance of highways. If this were done, it would go a long way toward reviving the construction industry.

Uncertainty as to what the future will bring is retarding this very important field. No contractor will purchase costly and modern equipment, unless and until he knows there will be future contracts on which it could be used. Pavers, rollers, grading equipment, finishers and other tools for building our modern highways do not wear out on a single contract. Their cost must be spread over three, five or more years. When road building is stabilized so that the constructor can count on a reasonable amount of future work, he can and will go ahead and arrange for the purchase of the necessary equipment.

Psychology for Highways

The greater the abundance of "Stop Street" signs, the less their effectiveness. A mid-way traffic line continuous throughout the length of the road would be practically useless everywhere, including the danger points. A road guard if invisible would lose 90% of its value. The actual physical prevention of vehicles from leaving the road is very important, but the sight of the guard is much more so, not only as a warning but as a reassurance to drivers.

Riding in a 40-passenger bus on an Alpine road with a nearly-vertical fall of a thousand feet five feet away on his right, the writer was somewhat reassured by the heavy stone posts at 25-foot intervals along the edge, until he saw these posts being lifted out of comparatively shallow sockets to permit some pavement repairs; and he was informed—and it was apparent—that a bus hitting a post when in place would hardly pause in its plunge to the valley below. The posts were there chiefly for their psychological effect on the passengers.

There are other applications of psychology to highway matters. A weed-grown roadside invites papers, lunch debris, etc. while only the most hardened vandal will throw such matters on a neatly kept lawn or weed-free shoulder; the great majority will save their rubbish for roadside receptacles if they are accustomed to seeing one every mile or two.

National Reemployment Service Furnishes Men for Public Works

Highway work to be carried on this year will require hundreds of thousands of men skilled in the different phases of such work, including grader operators, engine men, crane men, dragline and roller men, stationary engineers, tractor, bulldozer and truck operators, blacksmiths, carpenters, masons, stone cutters, form setters, spreaders, rock drillers, and concrete finishers. It is estimated that 50,000 such men will be needed in New York State alone, and a supply sufficient to meet the needs of contractors already has been recruited by the 62 offices of the State (one in each county) and National employment services.

The National Reemployment Service and offices distributed throughout the several States are ready to aid contractors, counties and others in obtaining such men, without cost to either party and, so far as local supply and demand permit, without bringing in help from outside the county, thus minimizing cost of transporting and housing the men and keeping the wages in the county. It would seem to be to the advantage of all concerned for public works officials and contractors to make use of this service.

CWA Safety Measures Save $7,500,000

Accidental deaths and injuries on CWA projects were approximately half of what were expected, as a result of the vigorous safety campaign that was initiated. It was expected, on the basis of experience, that 800 deaths would result, among the 4,000,000 people employed. To date, 347 deaths have been reported, and it is believed that the total will not greatly exceed 400.

Falling rocks, trees, timbers and cave-ins accounted for 113 deaths; 98 deaths were due to vehicles, chiefly trucks, the men falling off, being pinned against trees or walls, or run down, principally by trucks backing up; 58 deaths occurred from falls from trees, scaffolds, bridges, etc.

The 50 per cent reduction in deaths resulted in a probable saving of $1,500,000 in compensation costs, and the reduction in injuries probably saved upward of $6,000,000 in compensation and medical treatment. The safety program, when all items are accounted for, will cost in the neighborhood of $2,000,000. The cost per man per week was 3½ cents.

A striking illustration of the effectiveness of safety measures is shown by the fact that after Jan. 1, 1934, the death rate on CWA projects was 40 per cent lower than it was in November and December before the safety program got under way.

Work under the CWA is a thing of the past, but work of the same general nature, performed by unaccustomed workmen, will go on for many months, and the safety campaign should be continued. In fact, it may be expected to produce similar results on public works of all kinds, whether under state, county, city or private control. We wish to do our part, and with this purpose offer, in this issue, suggestions for the safe handling of explosives.

Work Relief Projects

(Continued from page 7)

Hints on Procedure

If the project involves a water distribution system and a treatment plant, or sewers and a sewage treatment plant, for instance, or a highway and a bridge, it is neither necessary nor desirable to hold the application until the final plans have been made for treatment plants or other structures. Indicate on the application that this work is part of a larger project; application can be entered later for the remaining parts of the work. In the meantime, construction can be started on the highway, the water mains or the sewers.

Since the allotments are limited, and the work for a small community may run into an amount of money that cannot be spared from the regular county allotment, it is often desirable to prepare a list of needy persons residing in the community. Armed with this list, and with an application for a "socially desirable" project, it is more than possible that a special allotment or appropriation for this project will be made directly by the state ERA, aside from the county allotment. The probability of securing such an allotment varies with the different states; in some it is far more likely than others. But it costs nothing, or very little, to try.

It is also considered desirable to so schedule operations that work will be carried on throughout the summer. It is better to plan to use 40 men for 6 months than 120 men for two months. This also fits better into the plan for allotting money.

What Are Desirable Projects?

About a month ago, the FERA issued an outline of suggested projects, which is briefly as follows:

A. Planning, including surveys, preparation of plans, maps, etc., especially when used as a guide to maintain worthwhile activity for future projects.

B. Public Property, including water and sewer construction, highway work, park and recreational facilities, power lines and power plants for municipalities, mosquito and rat control, etc.

C. Housing, remodeling and repair.

D. Producing goods needed for the unemployed.

E. Public Health, welfare and recreation.

F. Public education, arts and research.

Applications should not be presented for routine work—street cleaning, garbage removal, etc., but only for new construction.

Suggestions and Assistance

Two points should be emphasized: Apply at once, and don't be afraid to ask. Consulting engineers can save much money for local communities on many jobs of the types outlined. City and county engineers can be of real service to their communities. Sound engineering is most desirable. The rather hit-or-miss methods of the CWA should be a thing of the past. The CWA fulfilled its mission and did it well. A "new deal" is on the way.

PUBLIC WORKS is in touch with the FERA organization and will be glad to help anyone who applies for it, but we urge first that the local ERA offices be contacted. In most cases, information will be available through them, and their acquaintance with local conditions and with the state ERA is of much value. Do not be discouraged too easily. Prepare full data, as already outlined, and file the application—at once.

Payment of Water Rents by Indigent Consumers

HOW 21 Indiana cities handled the problem raised by non-payment of water rents by families who had been hard hit by the depression, many of them on the relief rolls, was the subject of a questionnaire circulated by H. A. Dill. The replies he received are summarized as follows:

Nineteen do not enforce regular rules, but 17 accept partial payments, sending collectors to obtain what is possible, and 1 allows accumulation of delinqnency to a determined amount or time.

Only one charges for turning on in all cases of delinquent bills.

The percentages of total revenue delinquent and unpaid on Nov. 1, 1933, varies from a minimum of 2½ to a maximum of 50; nine lay between 8% and 20%.

In only 3 cities did relief organizations pay all or part of the bills of consumers on poor relief, and in 4 the township trustee paid them under a 1933 State law.

In 12 cities some consumers worked out their bills on work for the company.

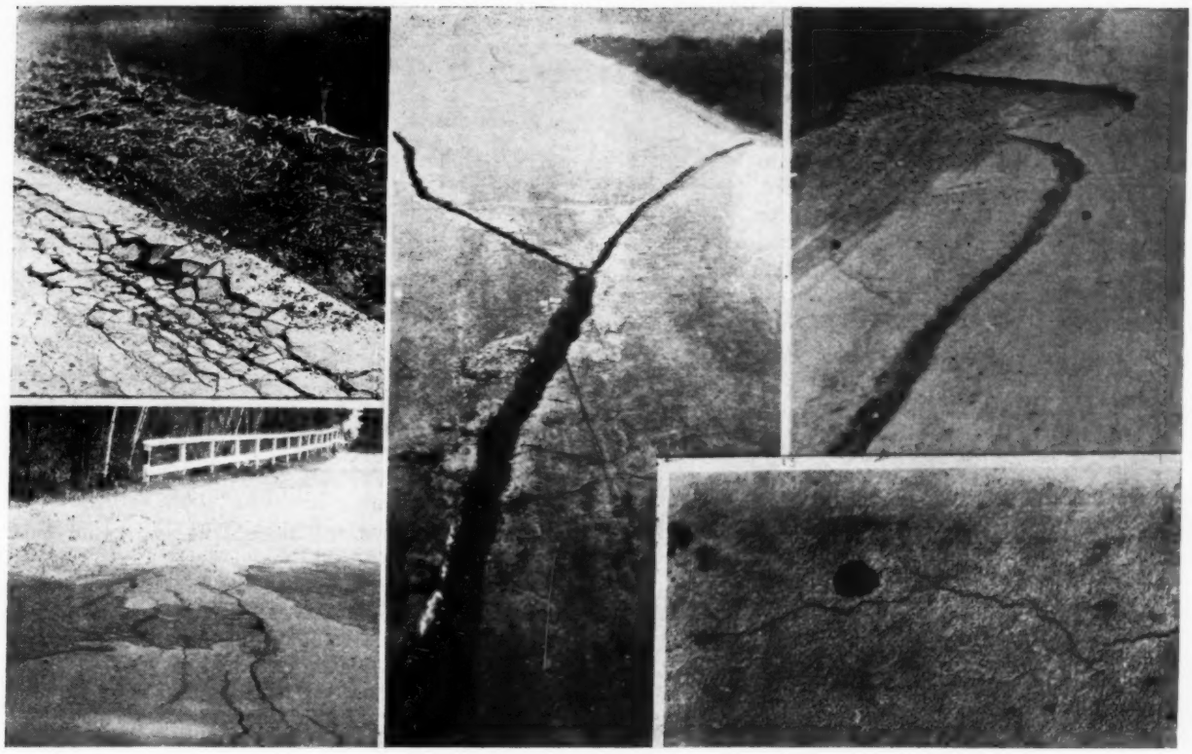
In 8 cities landlords pay or guarantee water bills of tenants.

In Dover, N. J., according to Geo. F. Steffany, president of the Board of Water Commissioners, "All bills must be collected when due." At the end of 1933 less than $150 was due on uncollected water rents and these were on vacant properties where the water was shut off. There are 2,500 metered services. "We have not changed our policy in these years of depression. All payments must be made to our office within 30 days to receive the 10 percent discount. Thirty days' further grace is given before payment becomes delinquent. Then we start collecting." If the rent is not paid the day after a telephone notice, the water is shut off, and $2 charged for turning off and on again. But those who can not pay are allowed to work off their water rents; the water department using these and having no common laborers regularly in its employ. Usually two days suffice, and then they are paid in cash and usually have a few dollars over. In some cases they work out bills not yet due, leaving their pay checks in escrow until they become due.

Comparative Costs of Lead and Leadite Joints

Bids were received on March 16th by the City of Pittsburg, Texas, for laying 70,979 lineal feet of 2-inch to 8-in cast-iron pipe, with valves, hydrants and 530 service connections using copper pipe. Alternative bids were received on laying the cast-iron pipe with lead and leadite joints. Four bids were received, varying about 15% from lowest to highest.

The quantities of iron pipe bid upon were: 3372 ft. of 2-in.; 54 ft. of 4-in.; 2320 ft, of 6-in., and 1250 ft. of 8-in. Each of the four contractors bid less for leadite joints than for lead, the least difference being $783, and the greatest, $2655. The lowest bidder's prices were as follows: 2″ joints—lead 75 cts., leadite 50 cts.; 4″ joints—lead $1.10, leadite 60 cts.; 6″ joints—lead $1.30, leadite 80 cts.; 8″ joints—lead $1.50, leadite $1.00. The lowest differences were: Nothing for 2″ joints; 8 cts. for 4″ joints; 20 cts. for 6″ joints; 25 cts. for 8″ joints.



Cracks in pavements due to: Left top—Gumbo subgrade. Left bottom—Frost boil. Middle—Other subgrade conditions. Right top—Settlement of fill. Right bottom—Expansion of subgrade.

Soil Analysis

Utilization in Economic Highway Construction

By C. A. Hogentogler

Senior Highway Engineer, U. S. Bureau of Public Roads.

MOTORISTS traveling with comfort, speed, and safety over modern highways and even engineers charged with road design and construction are inclined to consider the road surface as supporting the weight of traffic. On the contrary, this support really is furnished by the ground beneath, or the subgrade.

The main function of the road, of course, is to furnish a satisfactory riding surface, which purpose requires a structure capable of withstanding (in addition to temperature effects and abrasion which result in blow-ups, bleeding, dusting, raveling, etc., and are not dependent upon structural adequacy) two sets of influences which individually or in some combination are productive of structural failure. These influences are: (a) deflections of the subgrade due to traffic on the pavement, and (b) volume changes of the subgrade soil due to causes independent of traffic.

In designing road surfaces, the significance of the failure of subgrade soil as compared with that of other structures must be kept in mind. Concrete, steel, brick, wood, and similar materials of construction have definite strengths which, if exceeded, lead to abrupt fracture. These strengths usually are well established. Soils, however, present a different problem. Generally, abrupt failure is not to be anticipated, and resistance to rupture is not an important consideration. The kind of failure to be expected is a more or less gradual heaving or settlement which may occur in amounts or at rates sufficient to damage or distort the alignment of any engineering structure founded upon the soil; and which may easily deform road surfaces beyond the limits of rupture and destroy the smoothness that is required for safe and rapid motor travel.

The design problem becomes two-fold: To provide (1) a road surface capable of spreading wheel loads over areas large enough to prevent detrimental settlements of the subgrade due to load and (2) treatment of the subgrade to prevent detrimental heaving or settlement due to causes independent of load.

Such design requires information as to the traffic loads, the allowable pavement deflection, the supporting value of the subgrade, the ability of the various road surfaces to distribute loads, and the extent to which different soils heave and settle due to climatic changes.

Some soils are so stable that road surfaces consisting of very thin layers of stone fragments impregnated with bituminous materials are satisfactory. On slightly less stable soils, the topsoil, limerock, caliche, traffic-bound or stabilized gravel surfaces are adequate. On other soils, moderately thick macadam surfaces are required to spread traffic loads sufficiently. Still other soils require concrete pavements to spread the wheel weights over large areas; and sometimes even the concrete pavement must be supplemented by substantial base or foundation courses as thick as 2 feet.

In an exceptional case in North Carolina, support furnished by the subgrade was so slight that rows of piles had to be driven to support a thick reinforced concrete pavement. In another case, new earth has been

substituted for the soft natural ground to depths of 20 feet or more to furnish adequate support for the road.

Soil movements caused by agencies other than load are negligible in some soils; in others they are great enough to be the sole cause of pavement failure. Heaving of some subgrades during the setting period of the concrete has caused pavements to crack; in other cases, heaving has been sufficient to burst pavements open, forming cracks several inches wide with the slab much higher on one side than on the other. Frost heaving may be negligible in one type of soil while in an adjacent soil under the same slab it may amount to a foot or more. Likewise, settlement is unknown in some locations; in others, the subgrade may recede from the bottom of the pavement leaving it unsupported for appreciable areas.

Settlement of subgrade over a peat deposit.

The properties of the subgrade soil, therefore, furnish an important basis for determining the type and the design of the road surface. In consequence, the subgrade research of the U. S. Bureau of Public Roads has been concerned chiefly with: (a) the determination of those properties which control the heaving and settlement of soils; (b) the study of the basic physical laws affecting the properties that produce heaving and settlement; (c) the development of tests to disclose the presence of these properties; (d) the arrangement of subgrades into broad general groups which reflect the tendency of their members to heave or settle; and (e) the determination of general combinations of road surface design and subgrade treatment required on subgrades of the several groups.

The progress of this work will be summarized in articles to appear in subsequent issues of PUBLIC WORKS.

Rolling Gives Best Compaction on Cement-Bound Macadam

A cement-bound macadam test road was constructed last year by the Portland Cement Association near Elmhurst, Ill., just west of Chicago. Sixty test sections were built, under varying conditions, in a total length of 1200 feet. This road was described briefly in the July, 1933, issue of PUBLIC WORKS, page 42.

On this road, three methods of compaction were used: rolling, hand tamping and vibration. In no case was more than one of these used on any test section. The results of these three methods of compaction, so far as riding qualities, strength and economy of material, are summarized in a report just issued by the Portland Cement Association.

Rolling.—A 5.8 ton tandem roller was used on fifty sections and a 3.3 ton tandem roller on six sections. Rolling started at the edges and progressed toward the center.

Of the 43 crushed limestone and slag sections on which rollers were used, all but 5 were rolled before grouting. Most were rolled twice over, though some were rolled 6 times over and others 8 before grouting. Measurements showed but little additional compaction when rolled more than twice over.

Where initial rolling was practical it reduced the voids and therefore the grout or cement requirements; it keyed and stabilized the coarse aggregate so that it was easier to maintain a true surface under final compaction; it reduced the amount of aggregate pushed into the subgrade.

The light roller smoothed the surface as effectively as the heavier one but gave less reduction of voids. The amount of coarse aggregate pushed into the subgrade was but slightly greater with the heavy roller.

Rolling after grouting had two important functions: It smoothed and consolidated the pavement, bringing up sufficient grout to cover the aggregate; it closed voids left by water escaping from the grout and in this way increased the strength of the slab. *These functions were best performed when rolling was delayed as long as hardening of the grout would permit.* Under conditions existing on the experimental road, an interval of 45 minutes to one hour between the time of grouting and rolling was found to give best results. Wet subgrades, low temperatures, high humidity, or non-absorbent aggregates would materially increase this interval.

Final consolidation required from 4 to 10 passes of the roller. Gravel required less rolling than slag or crushed stone. During rolling, a squeegee was used effectively, removing surpluses of grout from some spots to make up deficiencies in others. Rolling too early resulted in a quaky condition; made it difficult to obtain a good riding surface.

Hand Tamping.—Three sections, two of gravel and one of limestone, were placed and finished without the use of any mechanical compaction. After grouting, the surface was tamped over 3 to 4 times with the longitudinal tamping template. This consolidated the coarse aggregate very little but the pavement leveled up nicely and was entirely satisfactory.

As the reduction of voids was small, grout or cement requirements were higher than for rolled sections. Offsetting this, coarse aggregate requirements were lower because of reduced compaction and because there was no loss of material in the subgrade.

Vibration.—Two types of vibration equipment were used: a heavy wooden screed on which 3 vibratory motors were mounted; and a vibratory puddler consisting of a 3 x 4-foot wooden platform on which one vibratory motor was mounted.

Vibration was effective in promoting penetration only when applied at the time the grout was deposited.

Consolidation obtained by vibration is less than with the heavy roller but greater than by hand tamping. Grout requirements for vibration, therefore, came between requirements for rolled and hand-tampered compaction; coarse aggregate requirements are low because a negligible amount is pushed into the subgrade.

Roadside Improvement and Beautification

By Wilbur H. Simonson
Landscape Architect, Bureau of Public Roads

This is the last of a series of three articles which Mr. Simonson has prepared from data presented by him to the American Society of Landscape Architects

Collaboration of Landscape Architect and Engineer Desirable

Careful preparation in the planning and execution of the work in accordance with approved landscape design and horticultural standards is recommended. Careful consideration should be given to the detailed design as to the outline proportions and appropriate fitness of the various kinds of incidental highway structures such as drinking fountains, parking spaces, railings, headwalls, sidehill spring outlets, overlooks, vista points, picnic areas, and other similar features that the motorist sees and enjoys. An attractive piece of construction does not necessarily cost any more than an ugly one. The landscape architect and the engineer have a common problem of fitting the details of construction in close relationship with the surrounding countryside to produce a harmonious and natural highway setting.

Preserve Natural Beauty of Surroundings

A primary purpose of roadside improvement is to conserve and develop the natural growth along the highway borders. Frequently, a slight change in the grading of a slope, or in the location of a side ditch, or the occasional introduction of tree wells and underdrains, will save a particularly fine tree or clump of trees. Where a highway passes through woods, local widening of the right of way to provide a sufficient border of existing growth should be considered to give the effect of bringing the woods out to the highway rather than cutting them off at the right of way fences, as has so often been the practice heretofore. The preservation

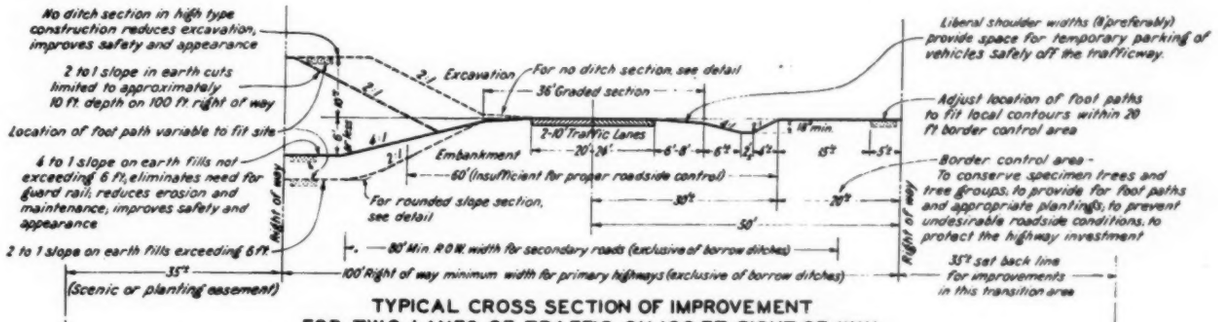
A simple landscape treatment for intersections, using low ground cover types of material to insure safe and open sight distance

of natural landscape areas along existing highways presents almost limitless possibilities in the development of the roadsides for the fullest recreational use of the public.

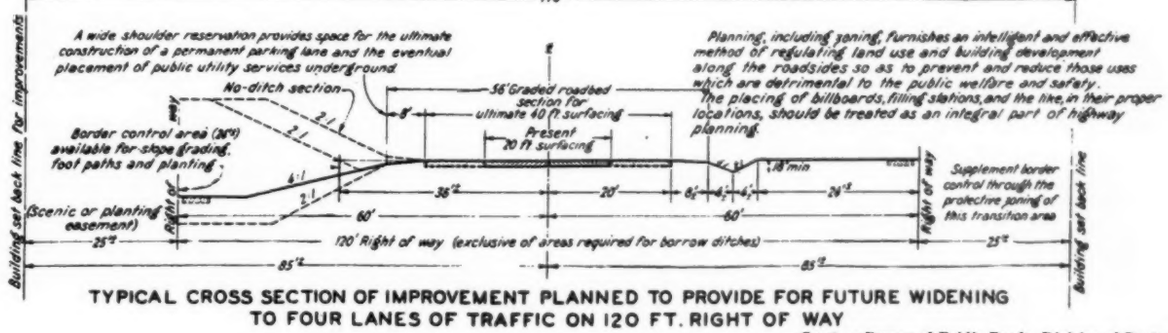
It is not desirable to set up hard and fast rules for landscape grading because varying local conditions require variation in treatment. General rules, however, may be prepared by the landscape architect so that the engineering organization may apply general principles to cases as they are encountered.

Steep Slopes on Cuts and Fills Undesirable

Proper grading should place the new cuts and fills in a natural and close relationship with the surroundings. The uniform steep slopes on cuts and fills which have been used in the past are artificial and are difficult to maintain. Slopes less steep are desirable for seeding



TYPICAL CROSS SECTION OF IMPROVEMENT FOR TWO LANES OF TRAFFIC ON 100 FT. RIGHT OF WAY



TYPICAL CROSS SECTION OF IMPROVEMENT PLANNED TO PROVIDE FOR FUTURE WIDENING TO FOUR LANES OF TRAFFIC ON 120 FT. RIGHT OF WAY

Courtesy Bureau of Public Roads, Division of Design

and sodding to improve appearance and to prevent erosion.

The object should be to make the new surfaces of cuts and fills flow into the existing contours with as little break in grade as possible. The side ditches should not necessarily follow parallel to the roadway or have uniformly sloping banks. In some cases, they may meander to miss trees or to follow the curve of a hillside. Ditch banks in favorable soils can be rounded or sloped so as to be almost unnoticed. Attention is called particularly to the departure from common practice in flattening the slopes of cuts and fills, and the transition or rounding of cut and fill slopes where they intersect the ground surface.

The roadside improvement problem, therefore, resolves itself into discerning what the terrain itself suggests as the line of least resistance, and then building the design thereon to fit naturally into the countryside. The aim is to go along with nature as far as possible, rather than the more costly contrary method of attempting to fit the land to the roadway construction, directly in conflict with nature. Roadside improvement aims to heal the scars of construction in a natural manner.

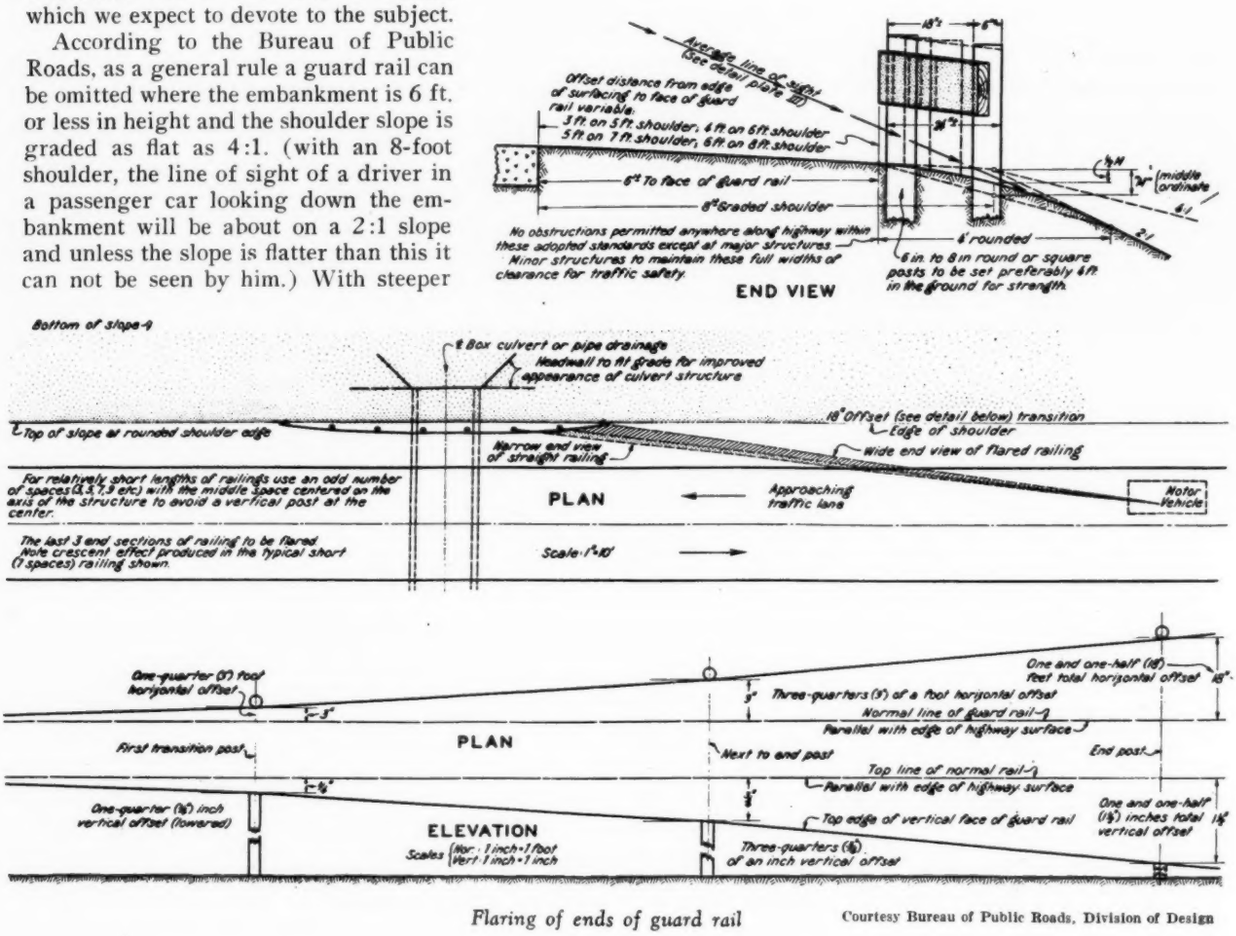
Roadside Appurtenances:

Other features of a highway besides the travelled surface should receive the serious attention of engineers and other highway officials, these including shoulders, ditches, culverts, guard rails, parapet walls, signboards; and conveniences at turnouts and parking sites, such as drinking fountains, refuse receptacles, and treatments of the surface of the parking sites.

The safety features are the most important; and of these, guard rails take a leading place, and will be considered first in the series of articles which we expect to devote to the subject.

According to the Bureau of Public Roads, as a general rule a guard rail can be omitted where the embankment is 6 ft. or less in height and the shoulder slope is graded as flat as 4:1. (with an 8-foot shoulder, the line of sight of a driver in a passenger car looking down the embankment will be about on a 2:1 slope and unless the slope is flatter than this it can not be seen by him.) With steeper slopes or deeper embankments, guard rails are desirable; and they are of course necessary at culverts and bridge approaches.

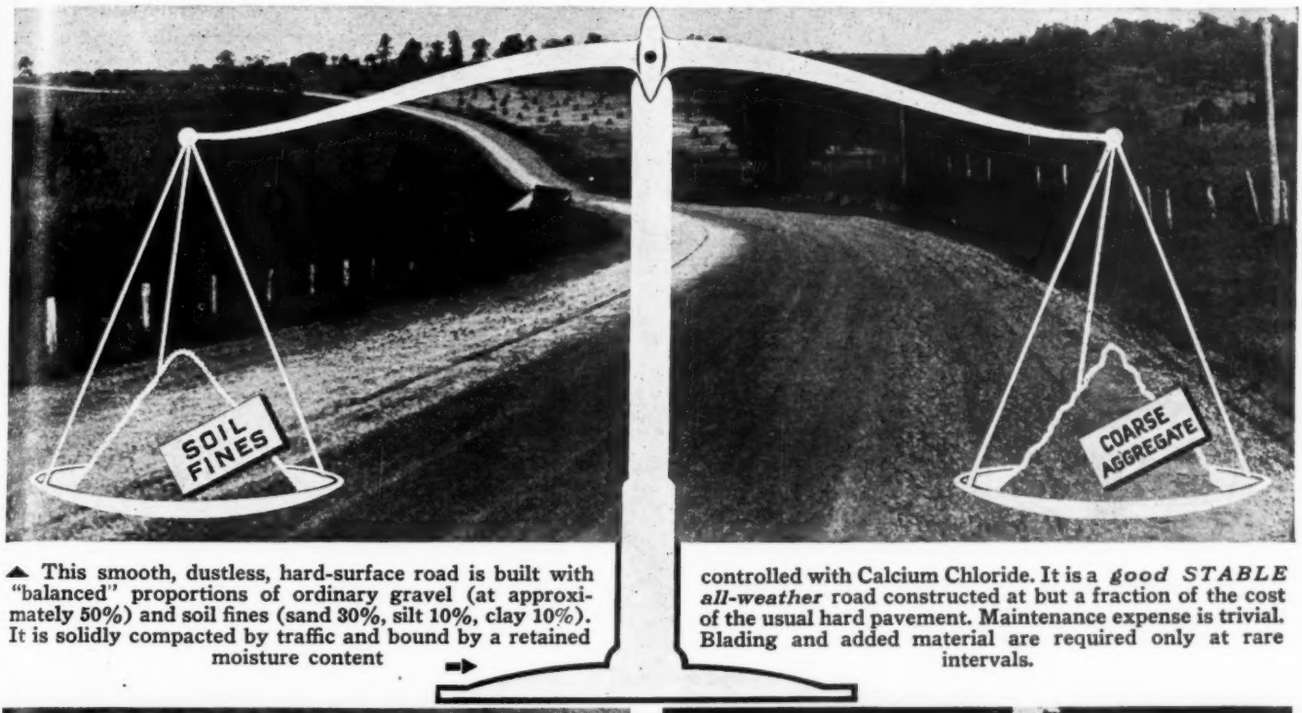
Receptacles for the disposal of refuse that accumulates near parking and picknicking sites should be supplied for the convenience of the motorist. Some highway departments utilize their empty tar barrels for this essential need after they have been cleaned and neatly painted grass green in color with appropriate lettering or highway symbols placed thereon for its identification. This illustration shows an uniquely designed concrete incinerator which resembles a tree trunk or stump in harmony with its natural setting. Boulders, native stone, or native logs may be salvaged for guard rails and bumper rails. Here is shown low post of native locust with iron chain. The locust posts were made from locust trees that had to be removed during the construction and clearing operations. This natural woodland was developed into a roadside park and picnic area through the careful selective cutting and trimming of the tree growth. Some native types of shrubs help to enframe the borders of the seeded meadow. The rustic looking receptacle and the simplicity of the post and chain in the foreground harmonize in this environment.



Flaring of ends of guard rail Courtesy Bureau of Public Roads, Division of Design

• LOW-COST ROADS •

scientifically designed for maximum stability by means of BALANCED soil composition



▲ This smooth, dustless, hard-surface road is built with "balanced" proportions of ordinary gravel (at approximately 50%) and soil fines (sand 30%, silt 10%, clay 10%). It is solidly compacted by traffic and bound by a retained moisture content ➡ controlled with Calcium Chloride. It is a *good STABLE all-weather* road constructed at but a fraction of the cost of the usual hard pavement. Maintenance expense is trivial. Blading and added material are required only at rare intervals.

▲ This soil road *(clay and silt)* is UNSTABLE because it lacks wear-taking gravel, slag or fine stone. Rain turns the materials into mud; sun dries them out; traffic plows them into deep ruts when soft, and crumbles them into dust when dry. Blading is of little value.

▲ This stone road is UNSTABLE because it lacks the bonding properties of moisture-retaining clay. Gravel remains loose and is ground to dust; traffic throws the materials aside. Frequent blading is necessary — and still the surface is unstable.

Balanced materials plus moisture supplied by Calcium Chloride — this is the key to low-cost hard-surface roads economically maintained. It is the road-building discovery of the age! Foremost U. S. Public Roads officials acclaim this "soil stabilization" method for secondary highway construction. A large and constantly increasing number of counties and smaller communities are using it. Many miles have already been laid — and have proved themselves the solution to the problem of maintaining highway systems with lean treasuries and benefiting a greater proportion of taxpayers.

Write for literature on "Calcium Chloride Stabilized Roads." Address any of the following members of the CALCIUM CHLORIDE ASSOCIATION:

THE DOW CHEMICAL COMPANY . . . . . Midland, Michigan
SOLVAY SALES CORPORATION . . . 61 Broadway, New York City
THE COLUMBIA ALKALI CORPORATION . . . . . Barberton, Ohio
MICHIGAN ALKALI COMPANY . 10 E. 40th Street, New York City

• CALCIUM CHLORIDE •

for stabilizing road surfaces

"With an 8-foot shoulder and 2:1 slope," advises the Bureau, "the low (24"+) hub or bumper-height guard with broad exposed face gives a greater feeling of safety to the average motorist on account of good visibility, especially at night, when the hazard is greatest.

"On the inside of curves in cuts, the use of a wide shoulder with flattened slopes increases traffic safety through improved sight distance.

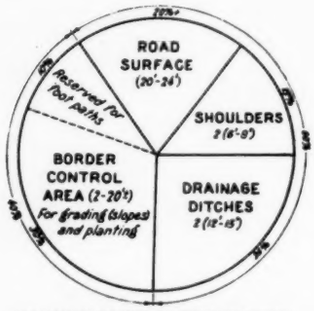
"Similarly, on the inside of curves on fills, the low (24"+) guard rail (with height to top of posts in no case exceeding 28 in. to 30 in. above the grade of the safely wide shoulder) affords clear vision over it."

"The average wheel hub height is approximately 15", while bumpers vary from 15" to 19". Line of force of average accidental impact against guard rail is approximately 17" above the ground."

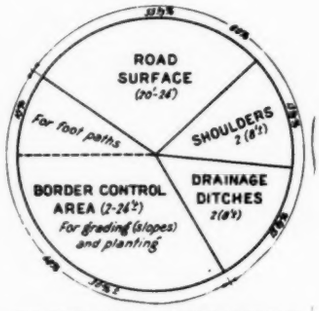
It is fully as important that a guard be seen as that it be able to keep traffic on the road by physical resistance. Collision with a guard post might be even more serious than running over the slope of the embankment. To add to the visibility, it is recommended that the ends of a guard rail be flared from parallelism with the road axis and also dip from parallelism with the grade.

The flare recommended by the Bureau is shown in the accompanying cuts. This "adds considerably to highway safety by exposing approximately three to four times as much surface to the vision of the driver, thus engendering a more favorable psychological reaction or feeling of security and safety in the mind of the highway user. The general appearance of the highway is also improved by this refinement in construction. Every scientific effort made by the highway engineer to improve traffic safety usually effects an equal or comparable improvement in the appearance of the highway."

Construction details of guards will be discussed in the next issue.

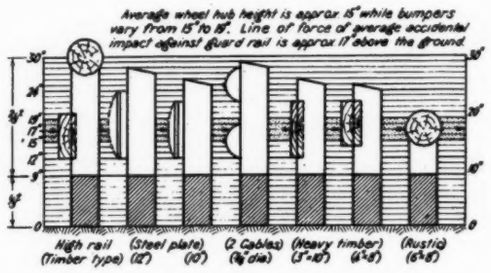


100 FOOT RIGHT OF WAY SECTION FOR 2 LANE HIGHWAY



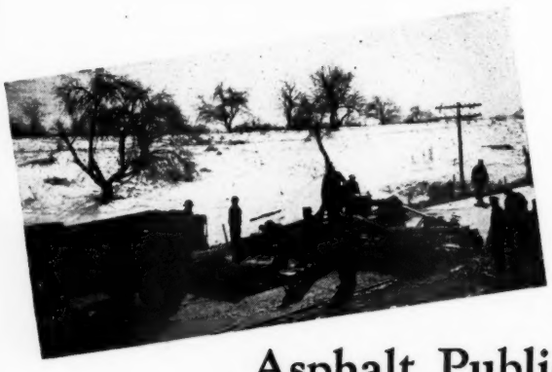
120 FOOT RIGHT OF WAY SECTION FOR 4 LANE HIGHWAY

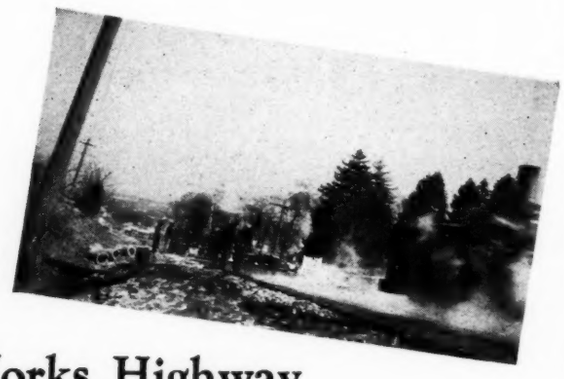
Charts showing approximate distribution of right-of-way areas
(SEE PAGE 24)



ALTERNATE LOW RAIL TYPES

Upper 2/3 white or aluminum for high visibility. Lower 1/3 black paint or creosote stain to avoid discoloration by rain wash and dirt spatter





Asphalt Public Works Highway Built in Cold Weather

IN spite of a 15-degree temperature, the Ohio State Highway Department on December 2nd began construction of a 20-foot bituminous concrete road 1 1/3 miles long in Pickaway County, on which 75 men were employed. The project was approved by the U. S. Bureau of Public Roads on October 6th at an estimated cost of $29,000.

The photographs show (1) asphaltic material being shoveled from a dump board in front of finishing machine; (2) smoothing by machine and testing with template, and (3) the completed surface.

FOR Year-After-Year ECONOMY
DEPEND ON TAR . . . . . FOR TAR DEPEND ON KOPPERS

11-Year Test in Suffolk, Va. Proves Tarmac's Economy

SUFFOLK, VA., has the facts and the figures to PROVE the year-after-year economy of Tarmac. In 1922-23 that city began an experiment with Tarmac treatments on unimproved streets. Bank gravel (containing 60% coarse aggregate from 1½ inches down; 30% sand and 10% clay) was treated with ½ gal. Tarmac P and ½ gal. Tarmac A and covered with 35# chips. This work . . . including the gravel and the grading . . . was done at a cost of approximately 90c per sq. yd.

These streets were not seal coated and did not require any re-treatment until 1931. In most cases the seal was applied the year following the original application. In one case, a street has already served 10 years without any seal coat.

"These streets have proved entirely satisfactory," wrote R. H. Brinkley, City Manager, and similar Tarmac treatments of other Suffolk streets were continued year after year until now almost one-third of the streets in Suffolk are Tarmac treated. After years of experience with Tarmac on this work, City Manager Brinkley makes these comments:

"It is easy to see the economy in this type of construction."

"These streets have solved the problem of furnishing good streets at low cost and have required little maintenance."

SUFFOLK STATISTICS

DOUBLE SURFACE TREATMENTS:
Prime: ½ gal. Tarmac P, sp. vis. 8-13 at 40°C.
Seal: ½ gal. Tarmac A, float test 60-150 sec. at 32°C.
Cover: 35 # chips, 1¼" to ½".

SEAL COATS: (when used)
¼ gal. Tarmac P, sp. vis. 25-35 at 40°C.
30 # sand

RE-TREATMENTS: (when used)
⅛0 gal. Tarmac P, sp. vis. 50-65 at 40°C.
Cover: 22 # —½" chips.

COSTS:

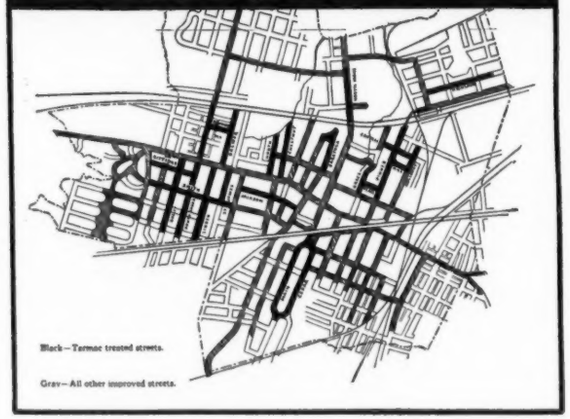
Double Treatment P and A
Tarmac: $.078 sq. yd.
Stone: .070 sq. yd.
Labor: .024 sq. yd.
$.172

Sand Seal Coat
Tarmac: $.0390 sq. yd.
Sand: .0097 sq. yd.
Labor: .0180 sq. yd.
$.0667

Stone Retreatments
Tarmac: $.035 sq. yd.
Stone: .022 sq. yd.
Labor: .020 sq. yd.
$.077

MAINTENANCE COSTS LESS THAN $50 PER YEAR
For year after year, this small sum paid all the costs of maintenance on the entire area of Tarmac streets in Suffolk.

Almost One-Third of all Improved Streets Are Tarmac-Treated



Black—Tarmac treated streets.
Gray—All other improved streets.

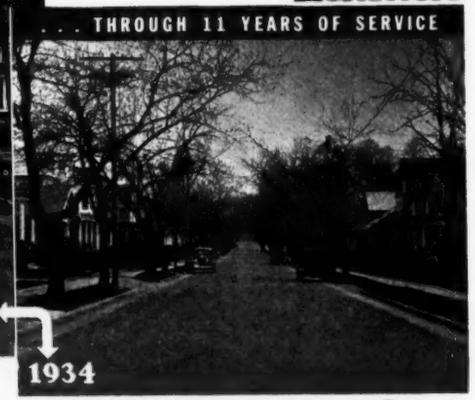
SUFFOLK STREETS TREATED WITH TARMAC

STREET	Date First P and A Treatment	Date of Seal Coat—(Tarmac and Sand)	Date of Retreatment (Tarmac and Chips or Sand)	Period between Seal (if any) and Retreatment
Brewer Avenue	1923	None	1931	8 years
Broad No.	1926	1929	None	5 years
Broad So.	1923	None	1931	8 years
Bosley Avenue	1929	1931*	None	3 years+
Cedar Avenue	1926	None	1931	5 years
Central Avenue E.	1931	None	None	3 years+
Chestnut Street	1924	1925	None	9 years+
Holladay Street	1930	None	None	4 years+
Linden Avenue	1925	1926	None	8 years+
Linden So. Maryland	1931	None	None	3 years+
Market Street	1926	None	None	8 years+
Mill Street	1931	1933*	None	1 year+
Grace Street	1924	1925	None	9 years+
Gittings Street	1929	1931*	None	3 years+
Smith Street	1929	1931*	None	3 years+
St. James Street	1925	1928	None	6 years+
Highland Avenue	1929	1931*	None	3 years+
E. Pinner Street	1925	None	1931	6 years
S. Pinner Street	1924	1925	1931	6 years
Pearl Street	1924	1925	None	9 years+
No. Saratoga Street	1925	None	1931	6 years
So. Main Street	1926	None	1931	5 years
North Street	1924	1925	None	9 years+
Jackson Street	1929	1931*	None	3 years+
Central Avenue W.	1925	1926	1933	7 years
Second Avenue	1931	None	None	3 years+

+Plus Sign—indicates there has been no re-treatment
*Chips used in place of sand for seal coat

TARMAC STREETS IN SUFFOLK, VA., . . . THROUGH 11 YEARS OF SERVICE

AS IT WAS IN 1923—Tarmac surface on Brewer Avenue, Suffolk, in 1923.



AS IT IS TODAY—Tarmac surface at same spot on Brewer Avenue, in April, 1934. The only treatment it has had in the 11 years was a light cold application of Tarmac P (3/10 gal.) in 1931.

AS IT WAS IN 1923—Tarmac surface on Broad Street, Suffolk, in 1923.

AS IT IS TODAY—Same spot in April, 1934. The only treatment in 11 years was light retreatment in 1929.

KOPPERS

KOPPERS PRODUCTS CO.
KOPPERS BLDG. PITTSBURGH, PA.

Other Products:
Creosote — Roofing — Waterproofing
Dampproofing — Traffic Paints — Tar Paints

Tarmac

Pages 36, 52 and 53 contain descriptions of many helpful booklets—Don't forget to look them over.

Tar Surface Treatment Cost Details

Eleven-Year Maintenance Costs on Wrightsville Beach Road Shows Economy in Stage Construction

By A. R. Taylor
Engineer, Tarmac Department, Koppers Products Co.

Wrightsville Turnpike, N. C., in March, 1923 (above) and in March, 1934

WRIGHTSVILLE Turnpike, New Hanover county, North Carolina, is an interesting example of how a road built 50 years ago has been improved by stage construction methods, at low cost, so that today it is still satisfactorily handling traffic. It was natural that this should be one of the first roads in North Carolina to be hard-surfaced, as it connects Wilmington with Wrightsville Beach, the leading seashore resort of North Carolina, and is located in New Hanover county, one of the first counties in the state to recognize the economy of gravel roads.

In 1884 New Hanover county decided something better than a dirt road was desirable between Wilmington and Wrightsville Beach, and accordingly surfaced the road with oyster shells for a width of nine feet, traffic being allowed to compact the shell. For the next thirty years the road was kept as a shell road, the only maintenance consisting of the addition of shell when the surface wore thin or became too rough. As traffic increased, this road became inadequate, both as to width and type of surfacing.

In 1914 the county commissioners authorized a bond issue for widening and surfacing with marl rock (which was to be quarried in the county) approximately 35 miles of roads leading out of Wilmington and serving a large trucking area and several beaches. Included in these was Wrightsville turnpike, about 9 miles long, which was widened four feet on each side with 9 in. of marl rock, while the old shell was resurfaced with approximately 2 in. of marl rock—more where necessary to bring the road to a uniform surface.

Where the depth permitted the marl rock was laid in two courses, a bottom one of 4 to 6 in. of rock and a top course of 2 to 3 in. of fine marl, which latter was used for resurfacing the old shell, being generally delivered wet and rolled until well compacted.

This resurfacing resulted in greatly increased traffic which, in a year or less, produced considerable wear. Also the roads were exceedingly dusty and proper maintenance was difficult and costly. The commissioners therefore decided to surface-treat them with tar and stone chips. The first application of tar to Wrightsville turnpike was made in July, 1915. The tar was applied at the rate of approximately 0.3 gallon per square yard, using an auto pressure distributor (about the first auto distributor employed for this type of work in North Carolina) and was covered with sand. This treatment cost approximately $850 per mile. The same year about 20 miles of other roads were surfaced with hot tar and stone chips.

These treatments proved so successful that in 1916 the county decided to continue them on other roads, in which year Wrightsville turnpike was treated with hot

Maintenance Costs of Wrightsville Turnpike over Eleven-Year Period

Year	Labor	Direct Charges	Team and Truck Expense	Road Tar*	Rock	Total	Per Mile
1921	$865.77	$119.29	$320.54	$1,586.46	$1,030.56	$3,915.60	$435.07
1922	485.70	73.03	501.66	868.12	186.21	2,114.72	234.97
1923	1.003.83	36.55	767.55	1,231.86	420.21	3,460.00	384.44
1924	1,059.10	69.75	703.79	2,243.37	770.30	5,246.81	582.98
1925) †							
1926)	458.53	57.17	458.81	228.93	575.95	1,779.39	197.71
1927	No records available for this year but maintenance not greater than average for other years.						
1928	375.94	219.63	253.63	186.99	108.95	1,145.14	127.24
1929	568.14	207.29	255.51	493.52	155.54	1,680.00	186.67
1930	293.23	81.24	64.43	214.49	35.93	789.32	87.70
1931	525.10	.....	972.66	2,779.96	1,338.24	5,615.96	624.00
1932	County roads maintained by State					100.00	11.11
					TOTAL	$25,846.94	$2,871.89
					AVERAGE		$ 261.08

*This includes material for retreatment and patching.
†Nineteen months combined, due to change in fiscal year.

Pages 36, 52 and 53 contain descriptions of many helpful booklets—Don't forget to look them over.

tar at a rate of ¼ gallon per square yard covered with stone chips, as a slightly heavier surface than the sand-tar was found desirable. After 1916, cold application tar replaced the use of hot tar except for a few retreatments made with the latter. Wrightsville turnpike was next treated in 1920, when it received 0.2 gallon of cold application tar covered with sand. This treatment was repeated in 1921.

The cost of maintaining this turnpike since 1921 is shown by the accompanying table, from which it appears that the average for the eleven years was $261.08 per mile per year. The costs given include all patching and retreatment charges.

Wrightsville turnpike was the only road leading to Wrightsville Beach until 1928, when the State built a new road to the beach. The material used in the construction of this new road was hauled over the old turnpike, with little damage being done to the surface-treated marl rock, as shown by the subsequent cost records in the above table. The road at this time carried an average traffic of approximately 2500 vehicles per day, and a maximum traffic of 4000 per day. After the construction of the new road in 1928 the traffic was divided between the state road and the turnpike, the turnpike handling on an average about 1000 vehicles per day and a maximum of 2500 vehicles per day.

Weed and Road Vegetation Control

Maintenance forces of the California Highway Department during the past five years have carried on a regular program of spraying and burning of roadside vegetation to minimize hazard from fire to crops, pastures and forest areas. Treatments totalled 1175 miles in 1932. The areas selected for treatment are generally along grain fields, pasture, forest and heavy brush lands. It is not applied through built-up areas, orchard, country or adjacent railroad right-of-way, which in effect produce a natural fire break.

The roadside growths are sprayed with oil and burned over under rigid supervision. The crews engaged on this work use every precaution to protect traffic, trees, shrubs, fence posts and other inflammable property.

Where infestation of noxious weeds occur, such as yellow star and Russian thistle, Johnson grass, Bermuda grass, hoary cress and puncture vine, infested areas are inspected at regular intervals, and spraying with 27+ gravity diesel oil is carried out at regular 10-day intervals, so there will be no opportunity for plants to develop sufficiently to seed.

Ohio State Highway Department to Study Warning Torches

Torches will be maintained permanently on sections of Ohio highways which are under repair. It has been found in the past that some torches have gone out, due to improper fuel, wind or rain. The Ohio testing laboratory has been directed by O. W. Merrell, Director of State Highways, to test the various types of torches. By means of a wind tunnel, the velocity of wind required to extinguish the torches will be determined; time of burning on one filling will be tested; and a novel artificial test is beng devised to tell approximately the amount of rainfall that will put out a torch. If a reliable torch is found, able to meet all these tests, it is contemplated to place such warnings at sharp turns, detours, and other hazardous places, as well as on sections under construction.

Prevention of Frost Heave in Highways

In the April issue we described the reasons for frost heave in highways and its relation to the soil type of the subgrade, slightly condensed from a report by the Bureau of Public Roads. In this issue we describe the preventive measures in use and the measure of success of each, as given in the same report.

VARIOUS methods used by different engineers in efforts to prevent frost heaving are shown in figure 5. Considering only the locations inspected in this survey, figure 5-*A* shows a method which has been used since 1921; figures 5-*B*, *C*, and *D* since 1928; figures 5-*E*, *F*, *G*, *H*, *I* and *J* since 1929; and figures 5-*K* to 5-*P* inclusive since about 1920.

The methods of excavating heaving soil and substituting a non-heaving material are illustrated in figures 5-*A* to 5-*I* inclusive

Figure 5-*J* shows excavation of the heaving soil, treating the bottom of the excavation with bituminous material to cut off capillary action and replacing the excavated material.

Drainage channels to intercept and direct water away from the roadbed are shown in figures 5-*K* to 5-*P* inclusive.

Generally no more than two years are required for the surface condition to reflect the effectiveness of the preventive method used. This is especially true of methods which do not serve the requirements of the location. In such cases heaving has been observed during the first winter after installation. Therefore, the results of methods which have been in service since 1929 are considered fully as significant as those which have been in service since 1920.

Results of Preventive Measures Discussed

The narrow center trench types *A*, *B*, and *C*, serve to eliminate only that heaving which might occur directly over the area of the excavation. The soil on the sides heaves sufficiently to crack concrete and bituminous pavements. The damage to gravel surfaces caused by the frost uplift is ironed out by maintenance after the frost leaves the ground so that there is no visible aftermath of the winter condition. These methods reduce the amount of break-up during the spring thaws and allow passage of vehicles. Compared with the results where no precautions are taken the benefits of this method are considerable.

Treatment for the full width of the traveled area as illustrated by type *D* has proven advantageous. There was no noticeable difference between the riding qualities of the surface laid over this type of treatment and adjacent sections where heaving had always been absent. The entire roadway remained smooth and firm during the spring thaw.

The V-type trench is very popular because it can be excavated with a blade grader, which materially re-

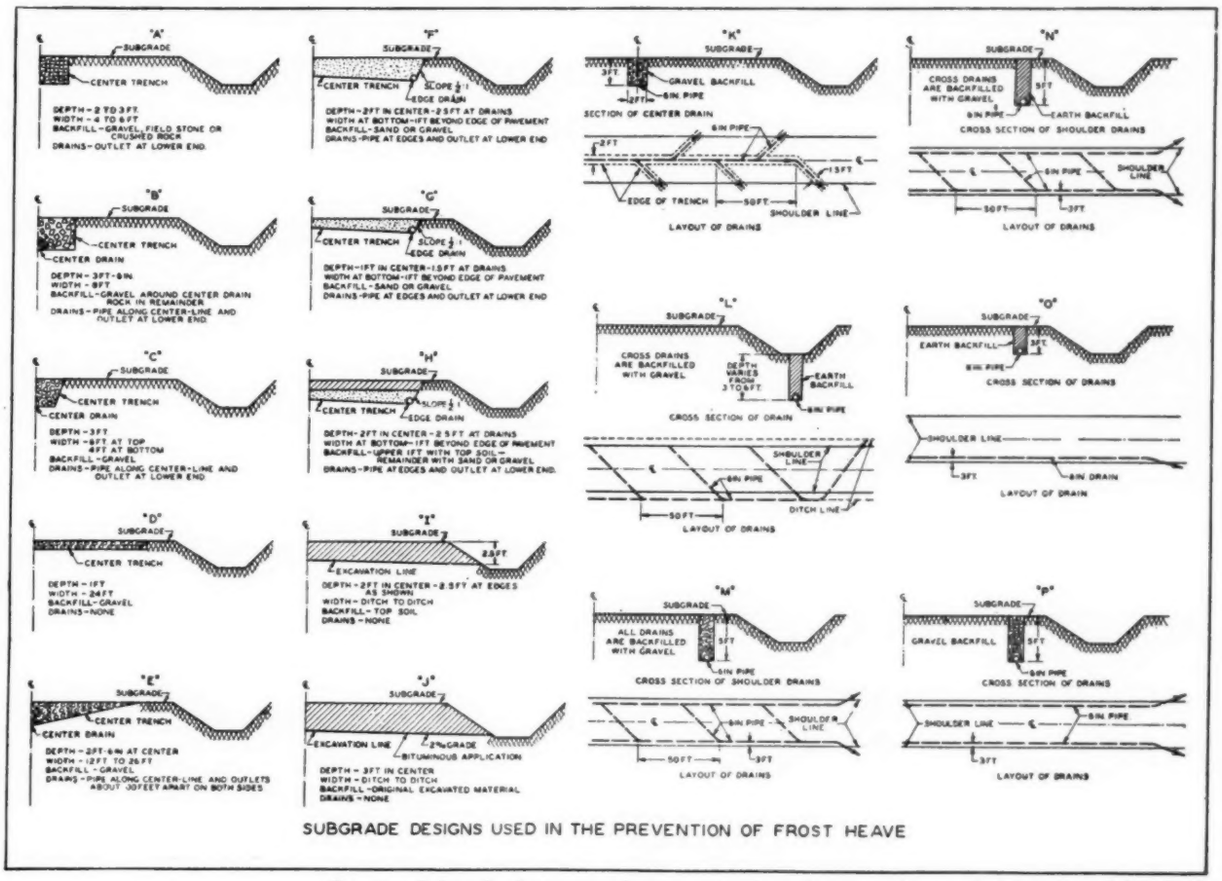


Fig. 5.—Subgrade designs used to prevent frost heave. *Courtesy U. S. Bureau of Public Roads*

duces the cost of excavation. In most cases surfaces laid over subgrades so treated carry traffic in a satisfactory manner. However, the heaving at the sides of the trench 12 feet wide in soil profiles *D* and *J* and the general heaving in the trench 26 feet wide in soil profile *I* has, in some cases, developed to the point where driving is safe only at very low speeds. The surfacing in the heaved area is badly broken.

Measures *F, G, H,* and *I* have proved satisfactory and reliable methods of preventing detrimental frost heave of concrete pavements. Except under the extreme climatic conditions of the northern parts of Michigan and Wisconsin, heaving is negligible in treatments where the excavation and backfill is not less than 2 feet. Noticeable but uniform heave has been measured in treatments 1 foot deep.

The method of excavating the heaving material for the entire width of the roadway, treating the base of the excavation with a bituminous material and replacing the excavated material has not been quite as successful as the full width treatments described above. Gravel surfaces on bituminous treated soils have become uneven and rough and cut up during the spring thaw. The heaving of a concrete pavement is noticeable but fairly uniform. Cracking is more pronounced than in the locations where a selected back-fill material was substituted for the excavated frost heaving soil.

The various kinds of treatment should not end abruptly but should be tapered or feathered out. According to observations by Andrew Seifert, concrete pavements laid on gravel back-fill tapered from 10 to 25 feet cracked considerably and became noticeably rough. Fifty-foot tapers have been more satisfactory.

With type *K* subgrade treatment the gravel in the trench remains in place while the soil at the sides is forced up. The heaving at the sides of the narrow trenches previously described is similar in nature.

The drainage types *L* to *P*, inclusive, have been of practically no benefit in preventing heaving of soils. In most cases the drains have been placed at arbitrary depths of 3 to 6 feet without regard to the type of soil or the arrangement of the soil layers. Type *M*, when installed in water-bearing sandy soils (soil profiles *C* and *E*) in such a manner as to conform to the soil profile, served to intercept and carry away enough of the water to prevent detrimental heave. This same type, when used in the stratified silts, fine sands, and clays (soil profile *I*), was of no value whatever.

Soil Profile Must Be Considered in Design of Drainage System

However convenient it would be to be able to establish definite and invariable spacing and depth requirements for drains, the hopelessness of thus standardizing drainage design becomes increasingly apparent as research in soils, especially for engineering purposes, progresses.

Failure to obtain the desired stability is definitely attributable in many instances to the attempt to apply arbitrary standards of spacing and depth in the placing of the drains without regard to prevailing conditions.

There is only one practical procedure and that is to place drains at such distances apart and at such depths as the interception and removal of offending moisture requires. And this, it can readily be seen, becomes a local problem, the solution of which depends upon such factors as the source of the water to be removed, the character of the soils comprising the different layers and the arrangement of the layers in the soil profile.

To further complicate the problem, some soils very readily give up their contained water and thus may be easily stabilized by drainage; other soils exercise a high affinity for moisture and are not apt to be stabilized by drainage. The only profiles found in this survey in which drainage can be reasonably certain to prevent frost heave are shown in figures 2-*C* and 2-*E*.

Figure 6-*A* shows how drains should be placed in order to prevent frost heave in soil profiles of the type illustrated in figure 2-*E*. Frost heave occurring in drainable soils due to a permanent high water table (fig. 2-*C*) may be eliminated by the system of drains shown in figure 6-*B*. It should be borne in mind that these methods are applicable only where the soil is more or less porous and does not possess appreciable capillarity.

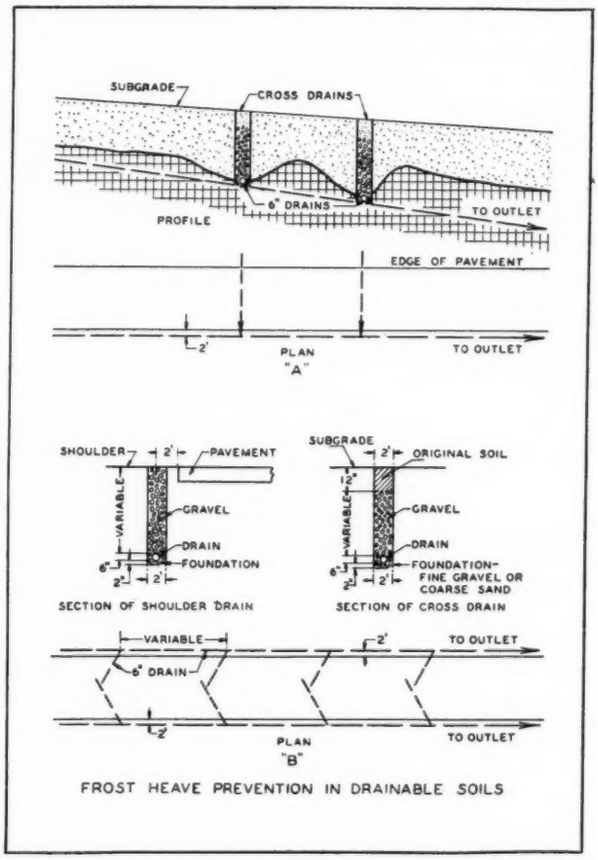
Conclusions

1. Center trenches reduced the heave of adjacent gravel road surfacing during freezing and increased stability during thaws to some extent. As a result the damage to the road surfacing which did occur could be repaired by ordinary blading operations. These benefits are not sufficient to justify recommending narrow center trenches as a standard preventive measure. However, where scarcity of gravel makes full width treatment prohibitive, center drains 3 to 6 feet wide on the less traveled roads, and not less than 8 feet wide, or a width of one traffic lane, on the more important highways, may serve as temporary expedients prior to the construction of more permanent surfaces.

2. The measures adopted to prevent frost heaving of concrete road surfaces should be effective over an area extending not less than 1 foot beyond the edge of the pavement and to a depth of not less than 2 feet. Excavation for the entire width of roadway and backfilling with selected material is preferable to the use of drains in excavated trenches.

3. The same preventive measures should be adopted for bituminous road surfaces as for concrete.

4. A porous granular material of the A-3 soil group



Courtesy U. S. Bureau of Public Roads

Fig. 6.—Method of preventing frost heave in drainable soils.

Pages 36, 52 and 53 contain descriptions of many helpful booklets—Don't forget to look them over.

should be substituted for excavated frost-heave soil. In locations where the cost of this type of material is excessive, topsoil may be used. The topsoil should be carefully selected from weathered soil layers and should be free from accumulations of lime.

5. Drains do not prevent frost heave in typical frost-heave soils such as the silts, silt loams, silty clays, and silty clay loams. According to the results of tests, most of these soils possess the properties of the *A*-4 group.

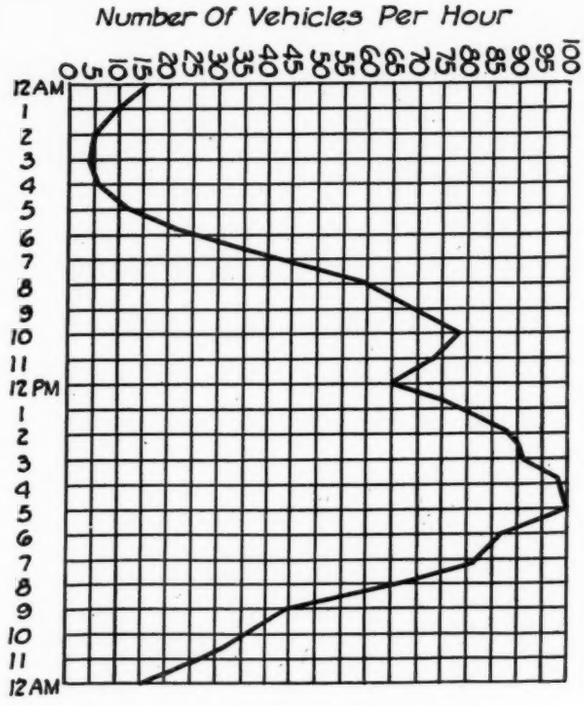
6. Frost heave caused by blocked drains or a high water table in porous A-3 soils may be prevented by the installation of drains. A thorough investigation of the soil conditions at each location should be made and the drainage system designed accordingly.

7. Frost heaving in profiles *C* and *E* (fig. 2) may be prevented by drainage. In order to eliminate detrimental frost action under the conditions represented by the remainder of the profiles, the frost heaving soils should be excavated (or grade line raised) and selected material placed beneath the surfacing. The type of treatment should be governed by the permanence of the surfacing and the traffic requirements.

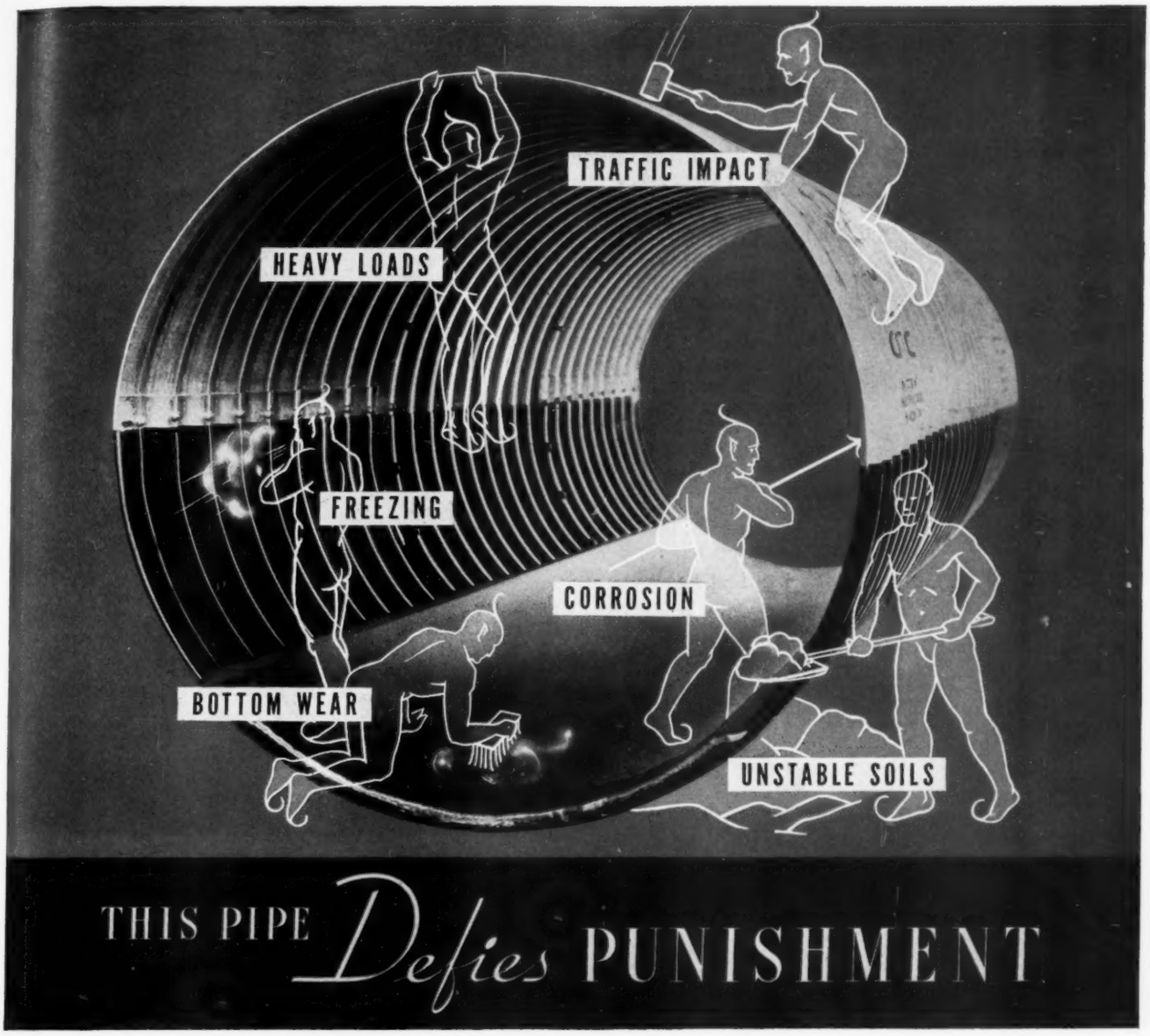
8. Information furnished by soil surveys, made prior to construction, should be utilized in fixing highway grades in such a manner as to correct the deficiencies of the natural soil profiles, with artificially constructed soil profiles. This practice will result in greater economy than the correction of defects in the subgrade after the grading and surfacing have been completed.

Hourly Distribution of Highway Traffic

From traffic studies made by the Kansas State Highway Department, the relative volume of cars per hour was determined, thus showing the peak and low traffic periods. The chart herewith shows the flow of traffic at a typical station. In comparing 24-hour counts with counts restricted to the 7 a. m. to 6 p. m. period, it was found that the total traffic is approximately 1½ times as great as that for the 11-hour period mentioned, though there was some variation due to the proximity to cities, and to local factors.



Variations in the Flow of Highway Traffic.



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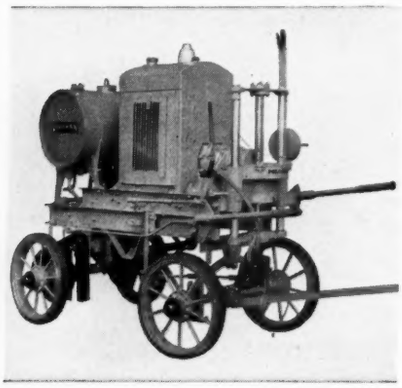
Pages 36, 52 and 53 contain descriptions of many helpful booklets—Don't forget to look them over.

Four Items of Highway Equipment

Core Drill to Work with Mud-Jacks:

A core drill has been developed by the Sullivan Machinery Co., 400 North Michigan Avenue, Chicago, which drills cleanly and without spalling through concrete pavements or gutters and is especially adapted for use with mud-jacks. The time required to drill



New Sullivan Core Drill

through 9 inches of pavement is 5½ to 7 minutes. This drill does not damage the roadway and provides a smooth hole. Operating costs are lower because less power is required than with a hammer drill. The core drill gives samples of the pavement at the same time. Further information sent on request.

"Laced" Highway Joints:

"Metal-Laced Joint" is the name of a new closed joint for concrete roads, just announced by the A. O. Smith Corporation, Milwaukee, Wisc. The accompanying illustration reveals the principle of design, involving a vertical plate through which is threaded a zig-zag steel rod. No stakes or supports are required. The plate is shaped so as to provide a very efficient slab interlock or transfer of load vertically, while the zig-zag rod serves to "lace" the slabs together. The joint is mathematically proportioned to use every pound of metal in the most efficient manner. Incidentally, this joint furnishes a desirable steel reinforcement of the slabs for 10 inches along adjoining sides. This ability to distribute stresses, set up by traffic, is an added feature to an already efficient joint construction.

"Metal-Laced Joint" is produced in standard 10-foot units, and designs are available for both longitudinal and transverse joints. A variety of rod diameters, plate widths and gauges are offered, providing various combinations to meet all of the different highway requirements. Its use permits considerable savings in time and labor.

75 Pounds of Demolition:

The new CP-117 demolition tool of the Chicago Pneumatic Tool Co., 6 East 44th St., N. Y., weighs 75 pounds, does not kick and does not require riding, so the manufacturers say. Especially suited to work in hard, dense concrete or medium to extremely hard material.

Leaving a Smooth Road Surface:

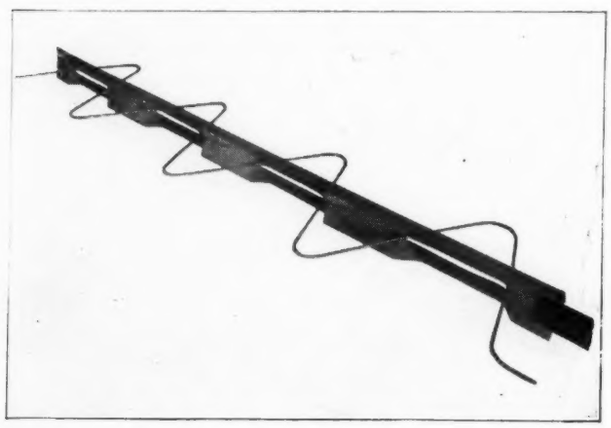
The Hi-Way Windrow Eliminator is an attachment for any motor patrol grader that completely eliminates the windrow deposited by the grader blade in the middle of the road. This windrow has been the cause of more highway accients on the state and county roads than any other hazard. In the interest of public safety, it must be eliminated and the Hi-Way Windrow Eliminator is the only tool on the market that can successfully do it.

The State of Wisconsin has so recognized the importance of this equipment that they pay the counties ten cents an hour additional for every motor patrol grader so equipped. The State has also decided that no windrows will be permitted on Wisconsin roads from now on. The elimination of this road hazard is an important highway maintenance problem not only in Wisconsin but in all other states.

The CP Demolition Tool

The operation of the Windrow Eliminator is simple, requiring very little attention during the day's run. Hydraulic lifts are provided for raising and lowering the blade. This blade is not a grading blade, and is only to be used for smooth spreading of the surplus material back across the graded surface and depositing stones and clods at the roadside. The blade is reversible so that the windrow may be taken from either side.

The Windrow Eliminator is available for attachment to all makes of motor patrol graders and is sold and serviced through all Road Machinery Dealers. Write to the Hi-Way Service Corporation, 3841 West Wisconsin Avenue, Milwaukee, Wisconsin, for more information.



The Metal-Laced joint gives an efficient slab interlock

The Windrow Eliminator at Work

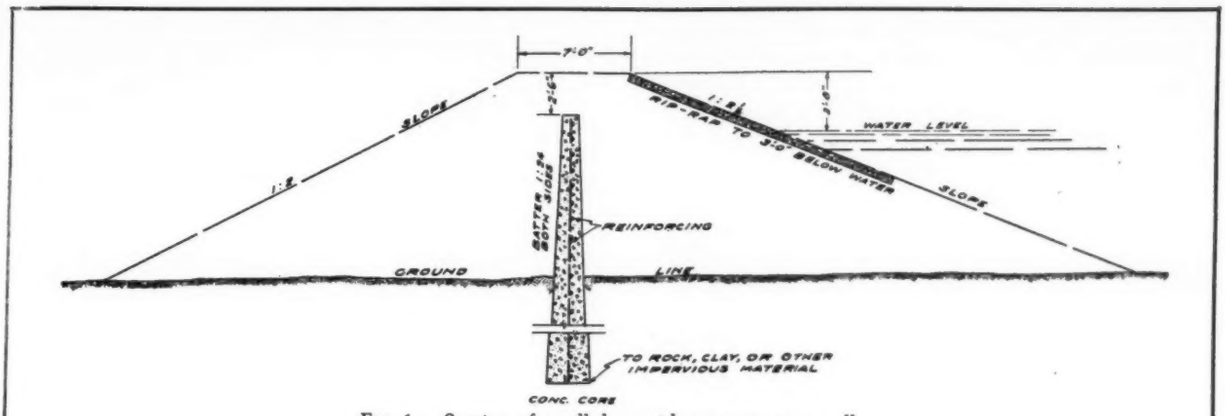


FIG. 1.—*Section of small dam with concrete core wall*

Design and Construction of Small Dams

By Frederick X. Conrad
City Engineer, Port Jervis, N. Y.

THE design and construction of a small dam is a business in itself. To my knowledge, there are not available any text books or hand books on this subject which discuss the features of this type of dam in great enough detail, to be of use to designers. As a rule, the cost of construction must be kept down rigidly.

The first thing usually asked by a man who wants to build a small dam is, "Will I have enough water to maintain a pond?" Unless the engineer is familiar with the locality and the nature of the stream to be impounded he cannot properly answer this question. He must, therefore, make an investigation and determine from available data the potential usefulness of the stream. When he becomes familiar with the nature of the stream he must then determine by some accredited method the amount of water available for impounding. Care must be taken that the average flow is determined. Many streams which are quite large in the spring go dry in the summertime. In cases where this occurs or the streams deliver small amounts of water in the summer time, particular attention must be paid to the design to prevent small leaks. Losses due to leaks and evaporation must be taken into consideration when determining the actual amount of water for impounding.

Costs

The next question, after the amount of water available has been determined, is the approximate cost of the dam; with the owner, this is often the most important factor. After a rough study has been made of the location and the type of dam to be used has been determined, a fairly accurate estimate can be arrived at. In estimating dams, we usually assume costs of concrete in the core walls and spillway at fourteen dollars per cubic yard and the earth fill at one dollar per cubic yard. We have found from experience that these estimates are sufficient to cover all other expenses, except engineering and clearing and grubbing for the dam and pond site.

Location

After determining the costs, the next point is the location of the dam. This should be the narrowest possible point which will give the owner a maximum expanse of water for his pond. As a rule, the narrower the space to be dammed, the cheaper it will be for the owner. However, the smallest dam is not always the cheapest. Often the sub-soil or other underground conditions are such that it is either impossible or unduly expensive to put a dam in that particular location. Care should be taken to make a proper study of sub-soil conditions before finally deciding on the dam site. It often occurs that an apparently good sub-soil is porous and has veins that will allow a large underground flow once the pond acquires a certain amount of head. I have seen water flow through a hole made by an old decayed root of a tree which, passing under the dam, gives small resistance to a flow of water. No dam should be built without a cut-off deep enough underground to eliminate this type of underground flow.

Determination of Type

The next thing to be considered is the type of dam to be built. Most engineers today want an earth dam with concrete core. An illustration of this type of dam accompanies this article. While this particular type is good in theory, unless the construction details are properly carried out it often is the worst possible type to build. Any crack in the concrete membrane will cause serious trouble in the earth fill. Hydrostatic pressure against the concrete will create heavy pressure through the cracks if the seams or defects are well below the water level, and immense pressure is built up. However, when properly built this dam is undoubtedly the best where the quantity of water is limited. This type of dam theoretically eliminates all leakage. It is easy to build and reasonably cheap. Masonry dams as a rule are out of the question due to the limited amount of money an owner is willing to spend.

Ordinary earth-fill dams without concrete cores have proven very satisfactory. If the upstream side is blanketed with clay, the dam is almost as impervious as a concrete core dam. Many old dams have a puddle clay center. These have proven very durable and, when well built, quite as satisfactory as concrete cores. It is doubtful, however, whether a five-foot or six-foot clay center is any cheaper than a concrete sheath. Clay, as a rule,

costs money and the work and equipment necessary to properly puddle runs into a certain amount of money. The clay blanket on the upstream side can often be built at small additional expense. It need only be rolled or tamped to be properly applied. If the blanket is later on covered with rip-rap to prevent erosion, a very satisfactory dam is produced.

Practical Sections

The first sketch shows a dam section with concrete core wall. This is the most commonly used section and is good when properly built. The wall must go to impervious material, otherwise the dam is apt to leak and the leak to develop considerable head. This plan shows some reinforcing in the wall, which permits a somewhat smaller section.

Rip-rap is shown on the upstream side to three feet below water. It is often wise to delay placing of this rip-rap until the fill has settled, for if this is not done but the rip-rap is placed at the time of construction, it will after a while get out of place and present a rough, uneven surface.

The concrete core wall is made of 1 : 2 : 4 concrete. It need not be poured monolithically if key ways are left at the end of each pouring. It is well, however, to plan the concreting so that the last two feet is made at one pouring.

The fill for this dam should be placed in layers not more than two feet and should be rolled with a roller when possible. However, if trucks are run over it continually and if the fill is hand-tamped it will prove satisfactory. In making the fill, all fine materials should be placed on the upstream side and big boulders or any rock fill should be placed on the downstream side.

The second sketch shows a dam with puddle clay center. This center should extend well below the surface of the ground or to impervious materials. In making the fill, a trough should be provided for the clay center, which can be done by keeping the earth fill ahead of the clay fill. The clay should be well puddled and hand-tamped in order to avoid hollow spots. If added protection is needed, a tongue-and-groove plank sheathing can be driven before starting the clay center. When this is done, the clay need not go to impervious material. The sheathing should extend well up into the clay. The fill is made approximately in the same manner as for the concrete core section.

The third sketch shows a dam section with a clay blanket. The depth of the blanket shown on the plan is three feet, and it should never be less than this and should be more on bigger dams. This is an ideal section for a low-cost dam. It has proven durable and almost water tight. The slope on the down stream side is 1 :2 and on the upstream side 1 :3. All of the clay blanket is covered with rip-rap. This is essential in order to prevent erosion.

The fourth sketch shows a concrete core wall with a

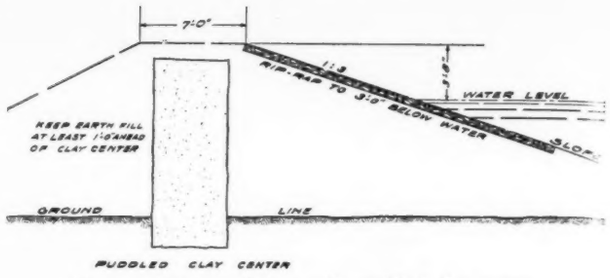


FIG. 2.—*Section of dam with puddled clay center*

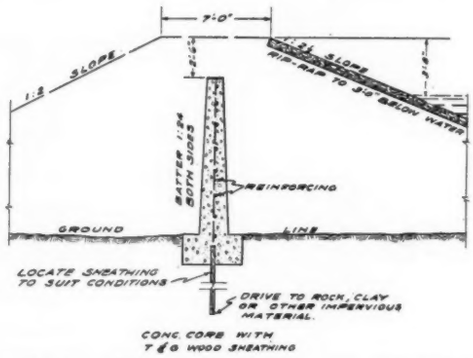


FIG. 4.—*Section of dam with concrete core wall and t & g sheathing*

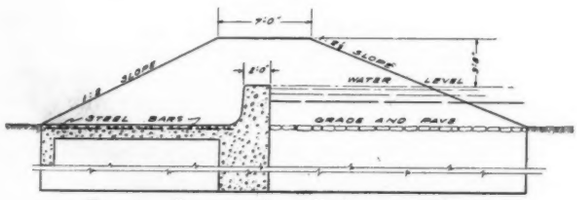


FIG. 5.—*Section of small dam at spillway*

tongue-and-groove cut off. When there are no big stones or the ground is soft and springy, this is an ideal arrangement when concrete is used for the core wall. It should be placed as near the toe of the wall as possible in order to eliminate toe pressure. This section is practically the same as shown on the number one sketch except for the sheathing as above mentioned. The concrete core wall has a footing the size of which depends on the nature of the foundation material. The same reasons that cause a designer to use wood sheathing will necessitate additional bearing surface for the wall.

The fifth sketch shows a section of a small dam at the spillway. This section has been approved by New York State as being safe. Care should be taken in designing this section that the base of the spillway wall is of sufficient width to resist overturning. A design which takes into consideration the added strength given by the spillway apron is not permitted; in other words, the dam wall must be designed on the basis of gravity section.

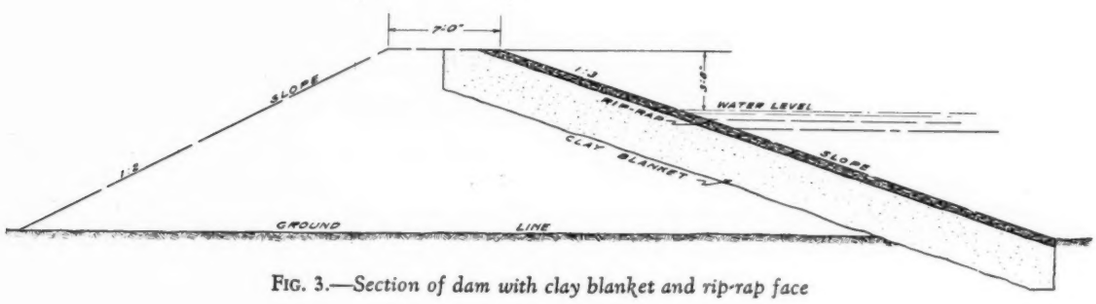


FIG. 3.—*Section of dam with clay blanket and rip-rap face*

A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published.

The Digestion Tank

CHLORINATION is used successfully at Fostoria, O., [C5-1] for controlling the profuse growths of green algae and other vegetation found in streams which receive biologically oxidized effluents, which "have come to be a problem of increasing importance. Such growths choke the flow, die and decompose to create a nuisance—all the result of high efficiency sewage treatment. . . . Rooted vegetation is not destroyed" by chlorination at Fostoria.

Activated sludge tanks are aided in their action by protozoological fauna, believes Emma Hamburg-Eisenberg[C5-1]. "The coating of slime adhering to the walls was investigated and found to be very important. By decreased aeration the load on the tank could be doubled when a good growth of slime was present.

"Plant construction during 1933 indicates that the activated sludge process remains the tried and approved method for producing the highest quality effluent. . . . Almost without exception the large cities of 500,000 or more population in the United States have selected activated sludge as their type of treatment. . . . There are 13 activated sludge plants serving about 900,000 population in Germany."

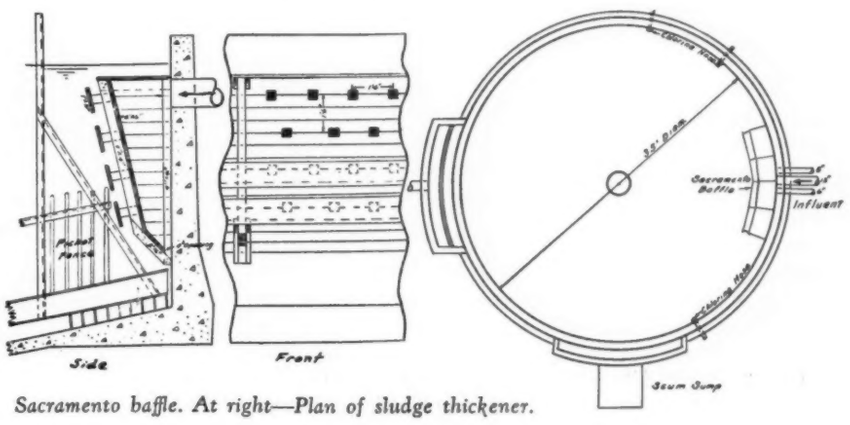
Among recent plants or those under construction are ones at Wards Island, New York; Cleveland's Easterly plant; Milwaukee's and Indianapolis' additions; Marlboro, N. J.; Sparta, Ill.; Mogden and Sheffield, England; Coalbridge, Scotland; Osaka and Tokyo, Japan; Colombes and Montmesly, France.

Condition of activated sludge can be judged by color, odor, setting, bacteria and protozoa[H5-2]. Generally a golden brown color indicates the best condition, and a pleasant, musty, earthly odor. Settling is the most universal index—the smaller the amount of sludge per unit of volume, the poorer the sludge. Protozoa furnish a better index than bacteria.

The pH of sludge is a popular index of the condition of digestion tank sludge. [C5-4] "Theoretically the pH should be lower at the bottom of a deep tank than at the surface, although when a sample is brought to the surface the loss of gas should allow the pH to rise toward its equilibrium value at the surface."[C5-3] "The colorimetric pH determination may be, if carefully made, a convenient indication of certain conditions in digestion tanks when the sludge is quite acid, but is at best an uncertain indication of the further progress of digestion after the pH is above 6.5." However, it "is by far the most popular method and when used carefully and with discretion probably gives the most satisfactory results."[C5-4] Among the satisfactory colorimeters are the La Motte, Taylor, Hellige Glass, Chicago Sanitary District and Duboscq.

Evaporating sludge is to be used for disposing of practically all of the sludge of the Sanitary District of Chicago[C5-1]. The plan, developed during the past two years, is to filter undigested sludge on Oliver filters, dry the filter cake in rotary dryers, and burn the dried sludge in the fire box of the dryer to provide the heat for evaporating the water. Such a plant, with a capacity of 20 tons per day of sludge on the dry basis, was operated for nine months and the procedure decided to be practical and preferable to digestion and drying. The latest development of this process is the use of Raymond hammer mills for drying and pulverizing the filter cake to a finely divided product with less than 15% moisture, which is blown into a pulverized fuel furnace and incinerated at a high temperature, in which all gases and evaporated moisture are deodorized. It is believed that no additional fuel will be necessary and the possibility of odors will be eliminated.

Spray-drying of sludge is effected at Plainfield, N. J., [H5-2] by means of a circular chamber 20′ diameter by 20′ high, through a hole in the center of the ceiling of which a centrifugal spray machine is inserted far enough to throw a horizontal spray of sludge, the small particles of which are spread into a current of hot air in the upper part of the drying chamber and give up their moisture content almost instantly. The solids coming from the dryer contain only sufficient moisture for convenient handling (about 20%) and look like mineral wool or sweepings from a vacuum cleaner. The temperature of the heated gas as it comes into contact with the sludge spray is reduced to 200° in one-half minute. A coal-burning furnace beneath the drying chamber provides the heated air.



Sacramento baffle. At right—Plan of sludge thickener.

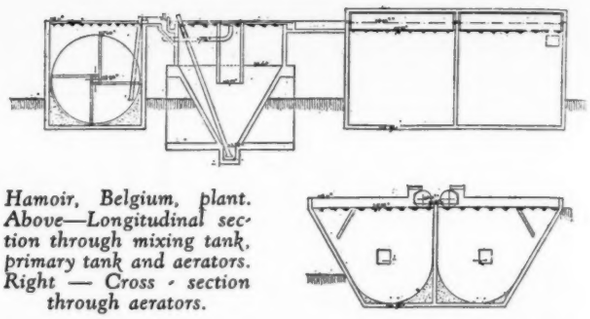
An **inlet baffle** known as the Sacramento type was installed in a sludge thickener in Phoenix, Ariz. [G5-1] when this—a tank 35 ft. diameter and 9 ft. deep at the circumference—short-circuited so as to be almost useless. After it was installed, using fluorescene dye, the distribution was found to be very good, with practically no short-circuiting, even when the flow was the capacity of a 12″ pipe line. The baffle built at Phoenix, shown in the accompanying illustration, "consists of a redwood baffle 24 ins. from the wall at the water surface, tapering to 9 ins. from the wall 36 ins. above the intersection of the vertical wall and sloping bottom. This baffle is perforated with 4-in. square openings on 18-in. centers, both ways. Nine inches in front of these openings are suspended wooden baffle boards 10 ins. wide."

Percolating filter plants, 90 in number, treat the sewage of 1,300,000 in Germany.[D5-7] The largest is at Stuttgart—38,900 cu. yds. filter capacity. A depth of 8 to 10 ft. is preferred. Medium—coke, slag and clinker, with about 15% stone; size about ¼ inch. All kinds of fixed and moving distributors are used, but American type nozzles in only two plants, while rotary distributors apply 65% of all percolated sewage. English type travelling distributors are little used as they freeze up easily. Dosing averages 120 g p d per cu. yd., running up to 250 of pure domestic sewage. Some percolating filters are followed by activated sludge treatment.

A vacuum trickling filter is being experimented with at Soest, Germany, [D5-7, H5-1] by chief engineer Blunk. Air, heated in winter to about 70° F, is drawn upward through a small, tightly sealed trickling filter. Results indicate that several times as much sewage can be treated as on ordinary trickling filters, with equally good results. The theory is that "(1) the quantity of air introduced in ordinary trickling filters is insufficient to rapidly and completely oxidize the organic material; (2) the CO_2 concentration in the lower part of the bed is toxic to the oxidizing bacteria, and (3) the cold air drawn in during winter is detrimental to maximum biological activities."

An aeration tank built like a circular Imhoff tank with a false bottom is a feature of the modern treatment plant at Soest, Germany, [H5-1] capacity 585,000 g p d of strong sewage. It is preceded by sedimentation and trickling filters and is designed to remove the small amount of suspended material coming from the trickling filters and oxidize further the material in solution. Air is introduced into the center of the tank at the bottom, 0.15 cu. ft. per gal. of effluent. The sedimentation chamber has a capacity of 0.4 cu. ft. per capita and the central aeration chamber 0.35 cu. ft. per capita. Preceding by trickling filters is claimed to give low air consumption, ease of operation (because variations in flow have been equalized by flowing through the plant), complete oxidation and low suspended solids in the effluent at all times.

Dairy wastes at Hamoir, Belgium, [C5-14] are treated by an activated sludge plant consisting of a mixing tank, primary settling tank, aeration tank, final settling tank and a separate sludge digestion tank. Last summer it was treating 37,000 g p d—designed for 92,500 g p d. Surface aeration by revolving brush is employed. In summer 40 lbs. of lime per day is applied in the mixing tank (none in winter). The digester



Hamoir, Belgium, plant. Above—Longitudinal section through mixing tank, primary tank and aerators. Right — Cross - section through aerators.

contains a wooden stirring device which rotates for 5 min. after each addition of sludge. Total power consumption for aeration, sludge stirring etc., about 60 kwh per day. "Analyses show that the effluent compares favorably with the water of a mountain stream into which it is discharged." The plant is operated by a factory laborer who makes routine tests. Sludge from the primary settling tank is mixed with the waste activated sludge and digested.

Digesting garbage with sewage sludge is still being studied by Keefer and Kratz. According to their latest report [C5-5] experiments so far indicate that (1) "a mixture of equal quantities of garbage and raw sludge on a volatile solids basis digests rapidly when seeded with the proper amount of digested sewerage sludge and kept at 28° C. (2) Daily additions of as much as 5% of the initial volatile solids, consisting of 2½% garbage and 2½% raw sludge, can be satisfactorily digested with the production of a non-offensive, easily dewaterable end product. (3) Although daily additions of raw material greater than 5% were not made, it is doubtful if quantities much larger than this can be digested with satisfactory results. (4) The total gas and methane production was about 750 to 800 cc and the methane 500 cc per gram of dry volatile solids added.

"It should be emphasized that all of the experiments, including the digesting of the materials in the steel drum, were on a laboratory scale. Before any final and comprehensive conclusions can be reached regarding the practicability of digesting mixtures of garbage and sewage sludge in considerable quantities, a series of large-scale experiments should be conducted at several municipalities over a considerable period of time, preferably with different kinds of garbage and sewage sludge." Baltimore has erected a garbage grinding station with a capacity of 20 tons an hour, the ground garbage to be discharged into the outfall sewer.

Commenting on these experiments, Prof. Fair says: [C5-6] "In the light of the results reported by Keefer and Kratz it would appear that normally the quantities of sewage solids (produced by a city's population) are inadequate to satisfy the demands for good digestion of all the garbage of a community with its sewage solids. It may be, however, that the material resulting from the digestion of suitable mixtures of garbage and sewage solids can itself serve as seeding material and thus more nearly meet the needs of the process."

"The presence of much less than 1 per cent of **gas liquor in sewage** (either as spent liquor or ammoniacal liquor) has a distinct retarding effect on sewage purification processes, due to the toxic constituents, and it is impossible to maintain satisfactory purification without entailing increased expenditure." [D5-1] So far as Mr. Scott knows, no economic remedy for the condition has been devised.

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c, Indicates construction article; *n*, note or short article; *t*, technical article.

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13. Fine Screening, Incineration and Sterilization Plant Construction and Features. By J. W. Van Denburg, pp. 309-317.
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2. *n.* Sewerage and Sewage Disposal in Germany, p. 328.
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2. Installation and Servicing of Porous Air-Diffuser Mediums. By Frank C. Roe, pp. 115-118.
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2. Sludge Problems. Discussion by N. J. Sewage Works Ass'n, pp. 125-126.
3. Licensing Sewage Plant Operators. Symposium, pp. 129-131.

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M — *Canadian Engineer*
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3. *n.* House Drainage in England, p. 12.
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5 — *February*

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Sewage Treatment Works in Ohio

The municipal sewage treatment works in Ohio as of August, 1933, are listed and described briefly by the State Department of Health in the Sixth Annual Report of the Ohio Conference on Sewage Treatment. The list includes 90, with 13 additional ones contemplated or under design.

Of the 90 plants in service, *bar screens* are used by 82, only one of which is mechanically cleaned; and of those contemplated, all include bar screens, 2 to be mechanically cleaned.

Fine screens are used by 2, contemplated by none.

Grease separators are used by 4, contemplated by 2.

Grit chambers are used by 26, of which 6 are provided with mechanical detritors, and contemplated by 4, 3 with detritors.

One-story tanks are used by 34, 12 with mechanical clarifiers, and contemplated by 10, all with mechanical clarifiers.

Two-story tanks are used by 52, 2 with gas collection, and contemplated by 3, none with gas collection.

Separate sludge digestion is used by 18, 10 with gas collection, and contemplated by 11, 10 with gas collection.

Open sludge drying beds are used by 66 and contemplated by 5.

Covered beds are used by 12 and contemplated by 4.

Sludge is lagooned by 4, none contemplate it.

Intermittent sand filters are used by 25, contemplated by 2.

Contact beds are used by 17, contemplated by none.

Trickling filters are used by 19, contemplated by 3.

Secondary fine-grain filters are used by 6, contemplated by none.

Secondary sedimentation is used by 18, 8 with mechanical clarifiers, and contemplated by 4, 2 with mechanical clarifiers.

Pre-chlorination is used by 6 and post-chlorination by 15, and 4 are contemplating post-chlorination, while 3 others are planning to use both.

Activated sludge with air agitation is used by 4 and with mechanical aeration by one, and the former is contemplated by one.

Mechanical filtration of sludge is practiced by none but is contemplated by 3—Cleveland, Columbus and Springfield, each of which proposes to incinerate the sludge.

If we compare, for each type, the percentage of existing plants which use it, with the percentage of contemplated plants which plan to do so, to learn the present trend, we find increased use for bar screens (10%), grease separators (233%), grit detritors (233%), one-story tanks (100%), and clarifiers for same (500%), separate sludge digestion (320%), and gas collection with same (600%), covered sludge beds (130%), trickling filters (10%) secondary sedimentation (55%), and mechanical clarifiers for same (70%), chlorine (135%), and activated sludge (45%). No fine screens, sludge lagoons, contact beds or secondary filters are contemplated, and only 60% as large a proportion of 2-story tanks, 48% of open sludge beds and 46% of sand filters. In proposed developments, therefore, gas collection from sludge digestors leads, sedimentation tank clarifiers are second, separate sludge digestion is third, and grease separators and detritors tie for fourth place.

The Water Wheel

Following are the essential features of the important articles published last month having to do with water works design, construction and operation and water purification, arranged in easy reference form and condensed and interpreted.

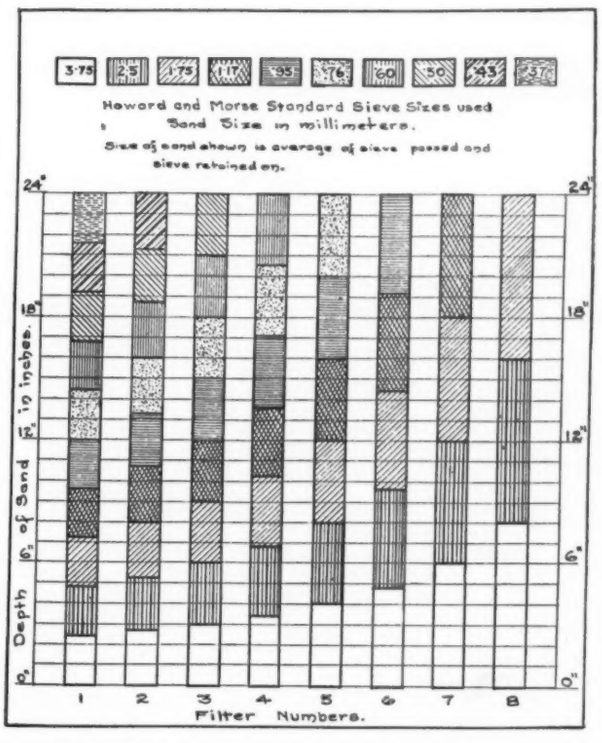
DIMINISHING of water resources in North Dakota and Minnesota is becoming serious[A5-1]. Lakes have receded 2 to 10 ft. The Red River of the North, navigable for steamboats in 1915, contained no water whatever for 156 days in 1933. Grand Forks in the winter of 1932-33 could obtain only 5 cfs from two rivers for a normal 6.5 cfs. consumption. Trees and whole forests are drying up. A reduction in population of 100,000 in the State of North Dakota during the past ten years is largely due to this. In many streams there is not sufficient dilution for the sewage, even when given complete treatment.

The remedy proposed is to dam the Missouri river 11 mi. south of Garrison, N. D., and divert part of its flow through 11 mi. of existing stream bed, 19 mi. of 14 ft. tunnel and 26 mi. of canal to the head waters of the Sheyenne river, thence through canals into the James river and Devils lake; also possibly into the Mouse river. From Devils lake, raised 20 ft., water would return to the Sheyenne river. Also water from the Sheyenne river would flow into the Red river above Fargo through practically a natural channel. Water reaching the James river would return to the Missouri at Yankton. Diversion of 1,000 cfs. for seven months of the year is contemplated. The dam would impound 10,000,000 acre-feet and cost $43,000,000. Diversion works would cost nearly as much more. Additional advantages —stabilization of flow in the Missouri and Mississippi; 80,000 hp. at the dam; irrigation possibilities for 13,000,000 acres; labor for 20,000 men for two to four years.

The yield of a well in Frederic, Wis., was increased five fold by a unique method[W5-1]. It was a 10″ well with an 8″ screen. At first it was "surged" to remove the sand from around the screen, but after several hours only 2 cu. yd. of very fine sand had been drawn in, and a test pump gave only 140 gpm with 108 ft. drawdown. Alternate hydraulic surging and bailing for a day gave practically no improvement. The only logical explanation was that the soil around the screen was a fat clay mixed with sand and gravel which could not be washed away by ordinary means. To break down the bond of this clay, 60 gal. of muriatic acid was poured through a 1″ pipe, extending to within 3 ft. of the bottom of the screen (which was of "Everdur" metal) for the first 12 gal., and raised 5 ft. for each succeeding 12 gal. After standing all night the well was surged slowly, while 100 gal. of water was run slowly into the well to force the acid into the clay. This was done four times with 2 hr. rests between. Meanwhile pH tests were taken of the discharge of a well 18 ft. away, dropping from 7.5 to 7.2 during the day. Surging then brought into the well mud, sand and fine gravel, and the test pump gave 260 gpm with 105 ft. drawdown. Then 108 gal. of muriatic acid was poured in and surged. A final test gave 300 gpm with 36 ft. drawdown.

Pollution of deep wells is possible (and occasionally proven) because of pollution of the underground source, faulty construction methods, or careless operation.[A5-8] Abandoned wells, if not plugged, permit a pure supply to be polluted by communication through them with a polluted supply in another stratum; or pollution may enter them from the surface or be deliberately discharged into them. (Sewage has been so discharged from a public sewer system.) Merckel advocates that all wells, other than shallow private ones, be placed under public health supervision, reinforced by adequate legislation, and be given more than mere nominal inspection and control. Also that there be more frequent bacterial and sanitary analyses and inspections of public well supplies. Disinfection is a justifiable, sensible and sooner or later a necessary safeguard, and "it is good sense to take such precautionary action before rather than after contamination is discovered."

Filter sand experiments at the Toronto, Ont., plant have been conducted during the past two years as a part of the investigation by a committee of the A. S. C. E. and the results obtained there have been described by Superintendent Allen of that plant.[M5-11, M5-13] Among other conclusions, he found that coarser sand than commonly employed in rapid sand filters can be used with



Dept and grading of sand used in small glass filters in Toronto experiments.

the advantage of longer runs, higher washing efficiency and greater ability to prevent formation of mud deposits.

Data were secured with a view to determining, for filtration with the various sizes of sand, (a) the ability of the filter bed to prevent the passage of floc; (b) the length of run; (c) the volume of water filtered during the run; (d) the effect of temperature on length of run. For washing—(e) the best rate of applying wash water to effectively clean the filter bed; (f) the effect of temperature on washing rates. Also the velocity of wash water required to lift sand of various sizes; depth of penetration of floc and volume of it retained between washings; extent of hydraulic grading of sand, the effect of temperature and viscosity on sand rise, and effect of local conditions due to organic content of the water, alkalinity, turbidity, color, iron or manganese.

Bypassing filters is provided for at Wilmette, Ill., [A5-7] provision being made whereby the high-lift pumps can, in case of an unusual fire demand, pump to the village water which has been settled only but not filtered. *But* doing so requires connecting a special fitting, "so that there is no danger of polluting the filtered water supply under normal operating conditions."

Zeolites on the American market are of at least three general types,[A5-11] with over 20 distinct products, including all substances that "possess the property of base exchange and can be employed as a medium for removing the hardness or calcium and magnesium from water by replacing these elements with a corresponding amount of sodium base of the softening medium." The zeolites most generally used at present are the greensand or glauconite, and the precipitated synthetic (sometimes called wet process synthetic). The fused synthetic was the first type used on a broad scale for commercial water softening, but is not being sold extensively at the present time. The clay group, manufactured principally from certain clays found in the Dakotas "do not possess the advantages of either high exchange power (as do the precipitated synthetic group) or of high resistance (as do the greensand or glauconite type)."

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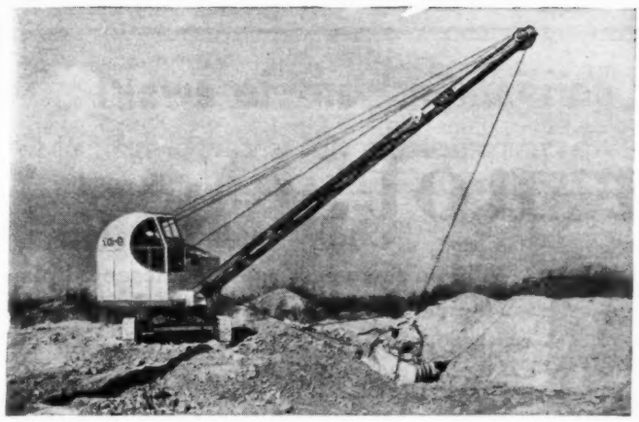


One of the New Bucyrus-Erie 10-B ⅜-yard excavators

Modernistic Designs in Excavators

The new 10-B, ⅜ yard excavator, just announced by Bucyrus-Erie Cmpany of South Milwaukee, Wisconsin, is an astonishing little machine. Fully and quickly convertible, it is offered with all types of front end equipment as a shovel, dragline, crane, clamshell, drag shovel, skimmer scoop, back filler, or pile driver.

Full-revolving, the 10-B offers practical working ranges that compare favorably with larger machines. The shovel with standard boom at 45° has a maximum cutting radius of 20′ 3″, a clear dumping height of 12′ 6″. The crane rating at 10′ radius is quoted at 7,000 pounds. Dragline and clamshell easily handle a ⅜-yard bucket on a 28-foot boom.

The machine weighs only 7½ to 8 tons depending on the equipment used, an important feature for those who must move their machines over highways.

More mobility is provided with speeds to 4¼ miles per hour. It steers accurately through friction clutches as readily as a tractor, making long, short or right-angle turns. It easily climbs grades even steeper than 30 per cent.

This new, full-revolving, ⅜-yard machine is remarkably compact, having a tail swing of only 5′ 7″. This makes it particularly suited for work in close quarters frequently encountered with a machine of this size. Among the many mechanical features that make the performance of the 10-B possible, are automatic lubrication; ball and roller bearings throughout; elimination of center pintle by the hooked-roller swing-circle which has proved so successful on Bucyrus-Erie's 16-B and large railway cranes; a new type of boom construction; a revolutionary new dipper; and power dipper trip.

Speeding Up Rock Drilling

This wagon drill is particularly adapted for drilling deep holes in quarrying operations, road work, deep rock cuts, and general rock excavation where such holes are required and drill steel changes in excess of 24″ can be used. It will handle drill-steel changes up to 10 ft. It is therefore possible to accommodate the drill steel change to suit the rock conditions within a wide range.

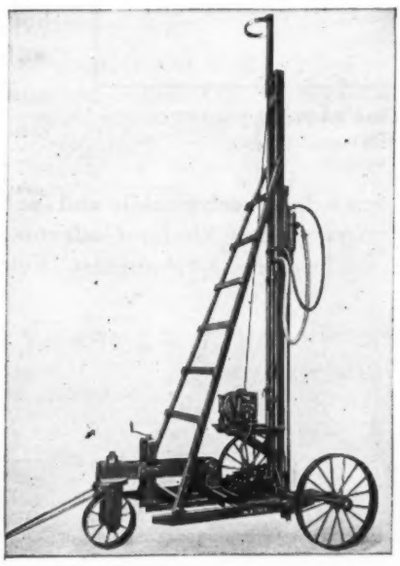
The larger holes, made possible through the use of the mounted drill, spaced at wider intervals will break the ground to better advantage. Further, it is not necessary to remove light overburden preparatory to drilling the rock where separation of dirt overburden from the rock is not imperative. These items represent real savings.

No. 50 drill is recommended for holes 18 feet deep or less; the No. 321 for deep holes. This wagon, with air hoist and No. 321 drill, can be operated from a 360-foot compresser.

The Worthington Pump & Machine Corp., Harrison, N. J., will send a bulletin describing this unit.

World's Largest Earth Fill Dam:

The Fort Peck dam, on the Missouri River, in Montana, will be 230 feet high, 100 feet wide at the top, 2,658 thick at the base, and 9,000 feet long. The reservoir created by the dam will be 16 miles wide and 180 miles long. It will serve a fourfold purpose: Flood control, a 9-foot channel in the Missouri, power development, and unemployment relief. A contract was recently awarded Westinghouse for $500,000 of electrical equipment for this project.



The Worthington Wagon Drill

Material Prices

(April 27, 1934)

Prices on cast iron pipe, net per ton, Class B, 6-inch and larger, AWWA specification*

Boston	$45.50	Baltimore	$43.50
New York	42.90	Atlanta	40.00
Chicago	44.00	Birmingham	36.00
Minneapolis	46.50	Kansas City	46.15

Burlington, N. J., $40.00; extra price for 4-inch, $3.00 per ton; extra for class A, $3.00 per ton.

**Information, courtesy U. S. Pipe & Foundry Co.*

Warehouse Prices on Reinforcing Steel and Structural Shapes

	Structural Shapes	*New Billet Reinforcing Bars*
New York	3.27c	2.52c
Boston	3.42	2.73
St. Louis	3.49	—
Cincinnati	3.45	3.10
Pittsburgh	3.05	3.00
Chicago	3.10	—
Philadelphia	2.75	2.505
Cleveland	3.36	2.10
San Francisco	3.55	2.35

Warehouse Prices on American Pig Lead

New York	5.00 to 6.00
Cleveland	5.10 to 5.35

U. S. Civil Service:

The U. S. Civil Service Commission is again in the field for topographic draftsmen of all grades, at entrance salaries of $1,620 to $2,600 per year, subject to the usual deductions. Applications must be in before May 22. Full information can be obtained from the Civil Service Board at any custom house or at the larger post offices, or from the Civil Service Commission, Washington, D. C.

Personal

F. Wellington Gilcreas has rejoined the staff of the Division of Laboratories and Research of the New York State Department of Health, as sanitary chemist in charge of sanitary and analytical chemistry. Mr. Gilcreas served on the staff from 1917 to 1924; since that time he has been chemist with Weston & Sampson, consulting sanitary engineers of Boston, Mass.

Irving C. Brower has been appointed city manager of New Rochelle, N. Y., succeeding John F. Donovan, city manager for the past two years. The salary of the office is $6,750. Mr. Brower is an engineer, and previously has been city manager of Pontiac, Mich., Lima, O., and Greensboro, N. C.

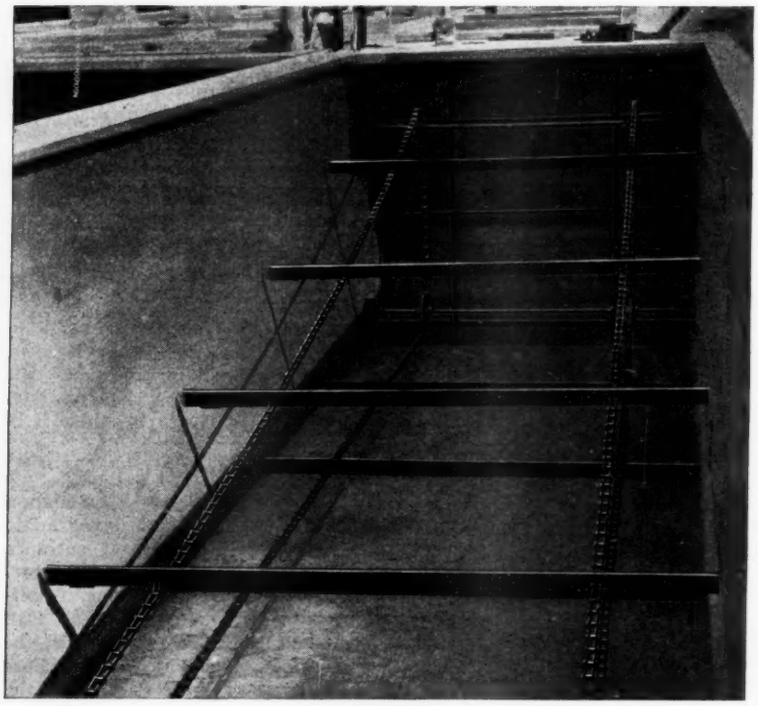
Fuller & McClintock, after nearly 30 years at 170 Broadway, New York, have moved their office to larger and specially planned quarters on the 16th floor of 11 Park Place, N. Y.

R. C. Yeomans, formerly with the Construction Materials Co., is now with the American Concrete Expansion Co., 221 No. LaSalle St., Chicago.

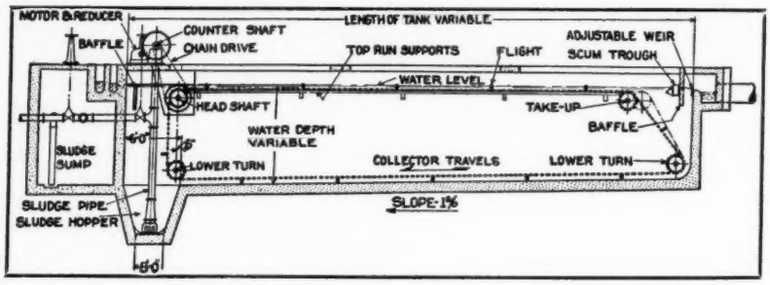
Charles B. Foster has been appointed sales manager to handle the entire line of the P & H Co., makers of excavators, trenchers, backfillers and pipe line equipment.

Short Talks with Sewage Plant Engineers

Believe it or not!



Straightline Collector in Final Tank.



Straightline Collector as used in Primary Tank where top run serves also as a scum collector.

Only a few years ago—the accepted plan for removing sludge from a sedimentation tank was to draw or pump off the supernatant liquid, and shovel or scrape the sludge into buckets, or shove it along the bottom to an outlet pipe. The improvement of making the tank bottom as a series of hoppers, with a drawoff pipe at the bottom of each, eliminated an exceedingly nasty and tiring job. And when removing the sludge by hydrostatic pressure through pipes placed in the hoppers was introduced a few years ago, it seemed as though perfection had been reached.

But hoppers seldom clean themselves thoroughly, no matter how steep (within practicable limits) their sides may be; the tanks must be narrow, or the hoppers wide and correspondingly deep; and every foot depth of hopper adds to the cost and carries the excavation that much further into quicksand, rock or water-bearing ground. No wonder that construction costs so often far exceed the estimate!

Putrefying sludge clinging to the sides of hoppers is no longer considered permissible; it causes offensive odors and scum, and nullifies all efforts to deliver *fresh* sludge to digestion tanks.

Removal of *all* sludge, at least once a day, mechanically and *inoffensively*, is the only approved modern procedure. *Link-Belt Straightline Sludge Collectors do this with any capacity of tank*, and keep the surface free of scum also. Send for Book No. 642

LINK-BELT COMPANY

PHILADELPHIA, 2045 West Hunting Park Avenue CHICAGO, 300 West Pershing Road
SAN FRANCISCO, 400 Paul Ave. TORONTO, Eastern Ave. & Leslie St. Offices in Principal Cities

4818

LINK-BELT

NRA MEMBER U.S. WE DO OUR PART

SCREENS ▲ COLLECTORS ▲ AERATORS ▲ GRIT CHAMBERS ▲ DISTRIBUTORS

Pages 36, 52 and 53 contain descriptions of many helpful booklets—Don't forget to look them over.

News of the Engineering Field

Meetings—Personal Notes—New Equipment Developments

American Water Works Association Meets

The 54th annual convention of the American Water Works Association will be held in New York City, Monday to Friday, June 4 to 8, 1934. Headquarters and meetings will be at the Hotel Commodore, 42nd St. and Lexington Avenue, adjoining the Grand Central Station.

Real business will start Monday afternoon, when the Plant Management and Operation Division and the Purification Division meet at 2 P. M., the former in the East Ball Room and the latter in the West Ball Room. Monday evening will be the annual dinner of the "Service des Eaux" under the general direction, we presume, of Jack Hinman.

The range of papers to be presented is very wide and many interesting topics are to be covered, with papers in all fields of water works engineering. The preliminary program for the convention was received too late for inclusion in full in this issue.

Registration may be by mail, or any time after 7, Sunday evening at the Commodore. Reduced railroad fares are provided, as usual. A golf tournament is set for Wednesday. A bus ride to Kensico and Croton Dams, with luncheon, is set for Friday, beginning at 10:30 A. M.

An excellent program has been planned throughout, and every water works engineer, superintendent and operator will find attendance well worth while.

Personals

John T. Fetherston, former commissioner of street cleaning of the city of New York, and now Vice-President of the Filtration Equipment Corporation, New York City, and president of the Selden Engineering Research Co., is one of eight alumni of New York University to receive alumni meritorious service awards at the hands of Chancellor Harry Chase Woodburn. The presentation took place on April 23.

James V. Vickrey and R. M. Gillis, acting district engineers of the California Highway Department, have been promoted to the rank of District Engineers. James G. Standley, formerly Administrative Assistant Engineer on the headquarters staff of the Department, has been made Principal Assistant Engineer.

"Dave" Kennedy is now Mid-west Sales Manager for the Adnun Engineering Co., makers of black-top pavers, and for the Foote Co., manufacturers of concrete highway pavers.

The Johnson-March Corporation, manufacturers of the "Hunt Process" of "Ritecure" and of "McEverlast," announce the appointment of Gloster P. Hevenor as Vice-President and General Manager; and, the removal of its offices from Long Island City, to The Vanderbilt-Concourse Building, No. 52 Vanderbilt Avenue, New York City.

George H. Cressler, formerly vice-president of the Stacey Mfg. Co. and of the Stacey Bros. Gas Construction Co., Cincinnati, O., has become a member of the Graver Tank and Mfg. Corp., Chicago, Ill. Mr. Cressler is a Yale graduate and served in the Ordnance Department during the War.

A Storage Battery for Trucks and Tractors

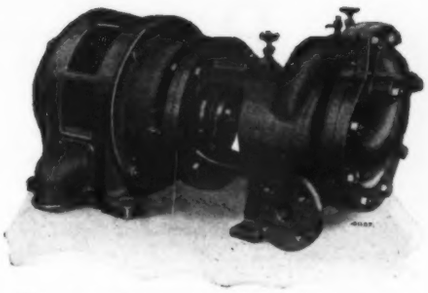
Following its recent introduction of the new "Electro-Pak" automobile storage battery for passenger cars, The B. F. Goodrich Company, Akron, Ohio now announces an extension of its line to include batteries made for practically every size truck, bus, fire truck, taxicab and tractor.

Plates in the new batteries are of special bus and truck design, heavier than those used for passenger car batteries. Separators are of the highest grade vertical grain Port Orford cedar, whose insulating strength is increased by perforated rubber sheets. This tends to retain the active material in the positive plates, and prolong battery life.

Bus and Truck T & H types carry a guarantee and adjustment policy for eight months or 24,000 miles, passenger car Super types in truck service 12 months, or 24,000 miles and passenger car standard and heavy duty types in truck service nine months or 18,000 miles.

Air Compressor Dope:

Gardner-Denver Co., Quincy, Ill., has issued new bulletins on compressors: AC-7 on air-cooled compressors and outfits; HAC-36 on horizontal, 2-stage, duplex compressors.



Two-Stage Motorpump for capacities up to 125 GPM against heads of 450 feet.

"Motorpump" Now Built in Larger Sizes:

The Cameron Motorpump is now built in twenty-six sizes ranging in horsepower from ¼ to 30, and in capacities from 5 gpm. to 1,000 gpm. Certain sizes are two-stage units and some other sizes are fitted with a self-priming attachment, which makes them suitable for use as sump or gathering pumps in mines.

The entire line, together with tables of capacities and performance data, is fully illustrated in new Catalog No. 7464, a copy of which can be obtained from Ingersoll-Rand Company, 11 Broadway, New York, or any I-R branch office.

The Golden Jubilee Asphalt Kettle

For some time, so say Littleford Bros., Cincinnati, O., highway engineers and contractors have been wanting a smaller 84-HD type asphalt kettle. This firm has announced the 84-HD-1, which is 50-75 gallon capacity, with double heat circulation, and screened reservoir. Instead of being mounted on a separate running gear, it is built onto supporting channels, but like the larger models it has Timken roller bearings, semielliptic springs and solid rubber or pneumatic tires—or steel, if desired.

In celebration of Littleford's fiftieth year in business—thirty-five of them building highway equipment—it is called the Golden Jubilee kettle.

Big Enough for Aunt Eppie Hogg

The air wheel buggy shown in the illustration is the newest thing in dirt-moving equipment. It handles 25 cubic yards, yet is handled easily by the Cletrac 80 tractor. It is made by Le Tourneau, out on the west coast, and was tried out on the Granfield, Farrar and Carling contract near Vallejo, Calif. On a 1450-foot haul it took 10 minutes for a round trip — 5 minutes out with a load, half a minute to dump, and 4½ minutes for return and spotting.

Readers' Service Department

(Continued from page 36)

To help you in your work, any of this **INDUSTRIAL LITERATURE** will be sent **FREE** upon request.

It is a good practice to check this list regularly because descriptions of new bulletins are always being added. ★

Construction Materials and Equipment

Asphalt Heaters

9. Illustrated manual No. 11 describes "Hotstuf," the master oil burning heater. The only heater with patented elevated melting chamber for Asphalt, Tar and all bitumens used in road and street construction and maintenance, roofing, water proofing, pipe coating, etc. Mohawk Asphalt Heater Co., Frankfort, N. Y.

Protective Coating

118. KRODEPROOF, the ideal protective coating for all structural surfaces subject to corrosion or contact with water is described in an 8-page bulletin recently issued by Lewis Asphalt Engineering Co., 30 Church St., New York, N. Y.

Concrete Accelerators

30. "How to Cure Concrete," a forty-seven page manual published by the Dow Chemical Company, Midland, Michigan, treats fully subjects suggested by title.

31. "Curing Concrete Roads with Solvay Calcium Chloride," 30 page booklet. Comprehensive. Contains tables, illustrations, suggestions for testing devices. Covers the subject in considerable detail. Solvay Sales Corp., 61 Broadway, N. Y. C.

35. "A report on Current Practice of using Calcium Chloride for curing Concrete Pavements, Bridges, Culverts and Concrete Products." It includes reports from the Highway Research Board, the Bureau of Public Roads and State Highway Departments. Columbia Products Co., Barberton, Ohio.

Concrete Mixer

44. Concrete Mixers, both Tilting and Non-Tilting types, from 3½s to 84s size, The Jaeger Machine Company, Columbus, Ohio.

Crushers

57. Up-to-date information on Stone Crushers, Stone Spreaders, Unloaders, Drags and other contractors' equipment from the Galion Iron Works & Mfg. Co., E. Jeffry Mfg. Co., Columbus, Ohio.

Culverts

60. "In diameters up to 10 feet and larger . . ." just issued by the Armco Culvert Mfrs. Assn., tells a good deal about drainage problems and their solution. 32 pages about drainage and multi-plate culverts.

Explosives

74. "Use of Explosives for Settling Highway Fills. A new booklet which fully explains by diagrams and charts the three methods developed after many tests by the Du Pont engineers, which singly or in combination will quickly and efficiently do your job. Just issued by E. I. Du Pont de Nemours & Co., Inc., Explosives Dept., Wilmington, Del.

Graders

76. Latest information about Galion Motor Patrol Graders, Road Maintainers and Leaning Wheel Graders with hydraulic control is contained in a new series of illustrated catalogs, Nos. 125, 130, 135 just issued by the Galion Iron Works & Mfg. Co., care of The Jeffrey Mfg. Co., Columbus, Ohio.

Hose and Belting

87. Complete information on rubber hose and belting for all types of contracting and road building service. The Government Sales Department of the Goodyear Tire & Rubber Co., Inc., Akron, Ohio.

Joint Filler and Line Marker

88. Bulletin No. G-9 issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates their new No. 91 Joint Filler which is used to fill horizontal and center joints with hot asphalt. It can be equipped to apply an asphaltic center line as it fills the center joint. This bulletin also describes the Littleford Traffic Line Marker.

Joint Filling Pot

89. A supplement to Bulletin No. E-5 has been issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describing their cone-shaped crack filling pot No. 86-B. The chief feature of this pot is that it is springless—there is no mechanism to get out of order. It is used to fill cracks and joints in concrete pavements and interstices in brick or granite block pavements.

Loaders and Unloaders

97. Portable Loaders and Unloaders. Folders: Nos. 1248, 1298 and 1074 cover Belt Conveyors with channel iron and truss types of framework; No. 1076, Portable Bucket elevators for different classes of work; and No. 1256, the "Grizzly" Crawler Loader for heavy work and large capacities. Link-Belt Company, Philadelphia.

100. Materials Handling and Positive Power Transmission Equipment, giving technical data, list prices and illustrations of this machinery. Link-Belt Co., Chicago, Ill. General Catalog No. 500.

Motor Trucks

105. Full information about their complete line of motor trucks, all powered by six-cylinder "truck-built" engines of uniform valve-in-head design, will be sent promptly. General Motors Truck Co., Pontiac, Mich.

106. "Trucks for Public Utilities," is a new illustrated booklet just issued by the International Harvester Co., 606 So. Michigan Ave., Chicago. Covers uses, types, special equipment, bodies and specifications. Sent free on request.

Paving Materials

108. "Emulsified Asphalts" is a 56-page manual covering Penetration Type Construction, Road and Plant Mixes Pavements, Surface Tratments and Maintenance Methods. Includes 58 illustrations. Sent free by Headley Asphalt Division, Sinclair Refining Co., P. O. Box 66, Marcus Hook, Penn.

226. "Asphalt Surfacing Materials for Low-Cost Roads" is a handy, 28-page booklet illustrating the many types of road surfaces which can be constructed with Texaco asphalt materials. Well illustrated and contains tables of amounts of stone, sand and asphalt required. Sent promptly by the Texas Company, 135 East 42nd St., New York, N. Y.

109. A 36-page booklet with 66 illustrations has just been issued by the Barrett Co., giving full information regarding the making, laying and maintaining of "Tarvia-lithic," the ready-to-lay pavement.

111. "Tarvia Double Seal Pavements." Shows, step by step, the construction of a Tarvia pavement. 24 pages. The Barrett Company, 40 Rector Street, New York.

112. Complete directions for surface Cut Back Asphalt are contained in a 36 treatment and bituminous surfacing with page data book. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

Road Machinery

126. A new general reference catalog No. 1320 covering their entire line of equipment for every approved method of construction and maintenance has just been issued by Austin-Western Road Machinery Co., 400 No. Michigan Ave. No. A-5, Chicago, Ill. Profusely illustrated with action pictures showing each type of machine out on the job.

127. "Road Machinery Illustrated." New illustrated bulletins on the motor rollers, three-wheel and tandem rollers, motor graders powered by Caterpillar, Twin City, Cletrac. McCormick-Deering and Fordson tractors, and straight and leaning wheel graders. Galion Iron Works & Mfg. Co., Galion, O.

5-34

★**Paste on post card and mail.**

Readers Service Dept.
PUBLIC WORKS
310 East 45th ST., NEW YORK

Please send me without obligation the following booklets listed in your INDUSTRIAL

LITERATURE SECTION .....
(INDICATE BY NUMBERS)

.....

Name .....

Occupation .....

Street .....

City ..... State .....

See additional descriptions on page 36

Rollers

132. A 32-page book in four colors featuring a complete line of road rollers. 8¾ x 11, leatherette cover, numerous action pictures. Buffalo-Springfield Roller Co. of Springfield, Ohio.

133. 20-page pocket size booklet showing all types of Buffalo-Springfield motor rollers and scarifiers and their uses.

134. "The Chief," a six cylinder roller of advanced design and construction is fully described in an illustrated catalog just issued by the Galion Iron Works & Mfg. Co., care of The Jeffrey Mfg. Co., Columbus, Ohio. Gives complete details of the very latest development by this company.

Sand and Gravel Washing Plants

140. Seventy-page catalog giving complete information regarding Sand and Gravel Washing Plants, stationary and portable. Those interested in such equipment should have a copy. Link-Belt Co., Chicago, Ill.

Shovels, Cranes and Excavators

145. The Austin Badger, a new, fully convertible ⅜ yard crawler shovel, made by The Austin-Western Road Machinery Co., 400 North Michigan Ave., No. A5, Chicago, is fully described and illustrated in their Bulletin No. 1236.

146. Link-Belt Co., Chicago, Ill., has issued Book No. 1095, which describes and illustrates their complete line of Gasoline, Electric, or Diesel operated shovels, cranes and draglines. 910 S. Mich. Ave.

Tires, Truck and Tractor

165. Speed and economy in use of solid, cushion and pneumatic tires and tubes for trucks, cars, tractors, graders and other road machinery. Government Sales Department of the Goodyear Tire & Rubber Company, Inc., Akron, Ohio.

Snow Removal

345. "Standard and Heavy Duty Reversible Blade Snow Plows for Motor Trucks," a new bulletin just published by the Monarch Mfg. Co., East Front St., Wilmington, Del. Illustrated. Contains complete descriptions and specifications.

349. "The Answer to the Snow Removal Problem." It gives full details of the Frink type S snow plow for trucks. Carl Frink, Mfr. of Clayton, N. Y.

359. Galion Iron Works and Mfg. Co., Galion, Ohio. Details, prices and catalogs of their snow plows adaptable to any make of truck.

Sanitary Engineering

Clarifying Tanks

383. Loughlin Clarifying Tanks for the more complete removal of suspended solids from sewage and industrial wastes at lower cost are described in a new bulletin just issued by Filtration Equipment Co., 350 Madison Ave., New York, N. Y.

Sludge Drying

385. Relatively dry cake sludge in demand for fertilizer is produced by automatic continuous vacuum filters like those used in Milwaukee, Houston, Chicago, Gastonia, N. C., Charlotte, N. C. Write for literature. Oliver United Filters Inc., 33 West 42nd St., New York, N. Y.

Activation and Aeration

390. A booklet of value to sanitary and chemical engineers describes Norton Porous Mediums of bonded fused alumina (strong chemically stable, uniformly permeable) and their use in aeration of water and sewage. Norton Co., Worcester, Mass.

Glass Covers

393. Full details regarding the use of Lord & Burnham Glass-Overs at Middletown, N. Y.; Marion, Ohio; Cleveland, Ohio; Freeport, N. Y.; Kitchener, Canada; West Chester, Pa., and other places are given in bulletins 22 to 33. Sent promptly on request to Lord & Burnham Co., Irvington, N. Y.

Jointing Materials

402. Full details concerning No. 1 Korite for sealing sewer pipe joints so that they will be permanently tight. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

Manhole Covers and Inlets

403. Nuisance from loose, noisy manhole covers is eliminated by the use of Westeel rubber cushioned manhole covers and gratings. Six special advantages are explained in a new illustrated bulletin just issued by the West Steel Casting Co., 805 East 70th St., Cleveland, Ohio.

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., South Bend, Ind.

Pumping Engines

413. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Screens, Sewage

417. The simple, automatic, Loughlin self-cleaning traveling screen is fully described in a new bulletin just issued by Filtration Equipment Co., 350 Madison Ave., New York, N. Y.

418. Sewage screens (Tark, Brunotte, and Straightline) for fine and coarse sewage; Straightline Collectors for Settling Tanks (Sludge, Scum and Grit), and Mechanical Aerators for activated sludge plants. Link-Belt Company, 910 So. Michigan Ave., Chicago, Ill. Book 642.

419. An illustrated booklet showing installations, and complete details regarding the 19 exclusive improvements which are featured in Shevlin Fine Disc Screens will be sent promptly by the Shevlin Engineering Co., Inc., 227 Fulton St., New York, N. Y.

420. A useful new bulletin for all those interested in sewage disposal, describing some of their proven equipment such as self-cleaning bar screens, grit conveyors, sludge collectors and shredders, has just been issued by the Jeffrey Mfg. Co., Columbus, Ohio. Includes diagrams and many illustrations.

Screens

424. Water Screen Book No. 1252, describes water screens and gives complete technical information about them. Link-Belt Co., Chicago, Ill.

Sludge Bed Glass Covers

426. Sludge Bed Glass Covers—"Super-Frame." Hitchings & Co., Main Office, Elizabeth, New Jersey. Offer A. I. A. File 101SB, describing glass covers for sludge and sprinkler beds; details, specifications and cost data.

Sludge Conditioning

382. Full information concerning the experiences in the use of ferric chloride for use in sludge conditioning and in coagulating sewage will be sent promptly by Innis, Speiden & Co., 117 Liberty St., New York. N. Y.

Pipe, Cast Iron

407. New 934 Handbook of Super-De Lavaud Cast Iron Pipe contains useful tables and data for the water works man on pipe line construction, weights, and dimensions. 40 pages, handy pocket size. United States Pipe & Foundry Co., Burlington, N. J.

Treatment

429. A new series of bulletins describing their full line of sewage treatment equipment—Fine Screens, Schofield Bar Screens, Vacuum Filters for Sewage Sludge, Decarie Screenings Incinerators, Schofield Bar and Fine Screens, Vacuum Filters for Sewage Filtration and Pneumatic Ejectors for Sewage Screenings—are ready for distribution on request to Municipal Sanitary Service Corp., Room 2703, 155 East 44th St., New York, N. Y.

430. Separate bulletins showing their many lines of sewage treatment equipment will be sent promptly by The Pacific Flush Tank Co., Chicago and New York. The latest is No. 110 describing tray clarifiers.

431. Eliminate sludge bed troubles, forget about weather conditions, odor nuisance, hail insurance and the like. Full details as to how Oliver United Vacuum Filters overcome these problems will be sent to all interested by Oliver United Filters Inc., 33 West 42nd St., New York, N. Y.

433. Collectors and concentrators for modern sewage treatment plants, recent installations, and full data on aerators, and screens. Link-Belt Co., 910 So. Michigan Ave., Chicago, Ill., and Philadelphia.

Index to Advertisements

For the Engineer's Library

The editors will be glad to assist readers in getting copies of publications mentioned here.

Modern Refuse Disposal:

A booklet descriptive and illustrative of developments in the field of refuse disposal, through the design and construction of Sterling Destructors, has been written by I. S. Osborn, vice-president of the C. O. Bartlett & Snow Co., Cleveland, O. Mr. Osborn is one of the leaders in the refuse disposal field and this booklet reflects his long experience. Copies on request to Mr. Osborn or to the Editor of PUBLIC WORKS.

Corrugated Metal Pipe Culverts:

An 80-page booklet has just been issued by the American Road Builders' Association, Washington, D. C., which covers in a most thorough fashion the design, uses and construction methods of corrugated metal pipe culverts. This is an excellent small textbook on culvert design and construction, and is worth a place in every engineer's library. We believe it to be free on request to the ARBA, National Press Building, Washington, D. C. Determination of size, recommended minimum and maximum sizes, storm run-off, alinement, grade and similar factors are covered; also, strength, loadings, durability and costs. The installation data include jacking and threading methods. In the appendix are proposed standard specifications of the AASHO, the design data for headwalls, and a very complete bibliography.

Truck and Trailer Weight and Size Restrictions:

The laws for each state, covering the size and weight restrictions on motor trucks and trailers, are arranged alphabetically for each state. The interpretations of the laws are arranged in tabular form and are approved by a responsible public official of each state, whose signature appears below the interpretation. This assures authoritative information. This edition covers the 1934 laws, and is a continuation of the service started some years ago by the Four-Wheel Drive Auto Co., Clintonville, Wisc. There are 56 pages. Booklet will be sent on request; there is no limit, so far as we know, regarding the number sent. Write the FWD Co. direct, stating the number you desire. Every truck driver will find the information of value.

Concrete Sewers:

The Portland Cement Association, 33 West Grand Ave., Chicago, Ill., has recently published the following: Concrete Pipe Sewers, 28 pp., illustrated, with some excellent data on the construction of this type of sewers. Monolithic Concrete Sewers, 20 pp., with a number of sewer sections of the larger sizes, but no design data; illustrated. Concrete Pipe Culverts, 24 pp., good data on loads on pipe in trenches, cradles, jacking concrete pipe, and flow of water through culverts. All these booklets are of different binding size. Sent on request.

Rattlesnake Bite Treatment:

Crotalus is not unknown to engineers, whose work so often carries them into wild country. The emergency treatment of rattlesnake bite, with especial reference to California conditions, is well covered in an article in the March 24 issue of the Weekly Bulletin, California Department of Health. Prevention, what not to do, and what to do—all important—are treated briefly and clearly. Write California Department of Health, State Office Building, Sacramento, Calif.

Rat Eradication:

Diseases spread by rats, something of their economic cost, and a copy of a model anti-rat law or ordinance are all covered in an article in the Monthly Bulletin of the Indiana Division of Public Health, Indianapolis, Ind. By modern methods of building, and by the use of poison, rats can be controlled or perhaps eradicated.

FERA Contracts:

The Federal Emergency Administration of Public Works, Washington, D. C., has issued as Bulletin No. 51, information relating to the negotiation and administration of contracts for federal projects under Title II of the National Industrial Recovery Act. Part I covers instructions to contracting officers; Part II covers instructions to Bidders and Contractors. Mimeographed, 25pp. Also printed, 12 pp.

Facts About Rabies:

The history of rabies goes back to 1300 BC. The procedure in handling animals, suspected of having rabies, which have bitten human beings or other animals, is outlined carefully. Some interesting facts about rabies are contained in a bulletin issued by Dr. W. F. Keller, State Department of Public Health, Oklahoma City, Okla.

Highway Construction:

Increased enrollment in its home study course in "Highway Construction and Road Building" is reported by the State of Massachusetts. A jump of 400% occurred during the first two months this year, as against the same period in 1933. New jobs, and the prospect of more, resulting from PWA and CWA road building and repair projects are the chief reason given for this increase in study. The course, divided into ten assignments, covers the latest and most approved methods of road building. Presented from a practical point of view, the course has been kept as non-technical as is consistent with an authoritative treatment of the subject. Enrollment in the course is open to residents of the United States. Details may be obtained from University Extension, State Department of Education, State House, Boston.

Blueprint Reading:

Training in reading blueprints intelligently is offered in a new short course for correspondence study, announced by the Extension division of the University of Wisconsin at Madison. In three parts, the course offers help in understanding general blueprint reading and either civil and structural or mechanical engineering blueprints. No time is spent in explaining how the drawings should be made, except where the method of drawing is essential to an understanding of the print.

This course was prepared by the Extension department of civil and structural engineering, Prof. H. E. Pulver in charge. A standard text is used.

Pumping Concrete:

The Chain Belt Co., Milwaukee, Wisc., has just published a new book on pumping concrete. This is a new and outstanding development in placing concrete. This book has 24 double size pages, and is largely pictorial, but it gives a very good idea of what pumping concrete is, how it works, and what the results are. This method of handling and placing concrete has been in use about a year. Copies will be sent free on request to Chain Belt or to the Editor of PUBLIC WORKS.

Catalogs and Bulletins:

Bulletin 60-B10 describes cycloidal rotary pumps, which are fitted best for handling viscous liquids. Roots-Connersville Blower Corp., Connersville, Ind.

Bulletin W-318-S3B (we believe that is OK) is the number of a recent bulletin issued by Worthington Pump and Machinery Corp., Harrison, N. J., and covering centrifugal pumps.

A 72-page Maintenance Shop Lathe Catalog has been issued by the South Bend Lathe Works, South Bend, Ind.

The new Brown Electric Flow Meter is described in a colored folder issued by the Brown Instrument Co., Philadelphia, Pa.

Electric power and lighting plants for use in portable service on excavation machinery, in mines and at construction camps are described in Bulletin EP1, issued by the Harnischfeger Corp., 4400 West National Avenue, Milwaukee, Wisc.

The new Allis-Chalmers oil tractors, KO and LO, are described in a folder just issued by the Allis-Chalmers Co., Milwaukee, Wisc.

Double Suction Horizontally Split centrifugal pumps are described in a recent very complete bulletin of the Morris Machine Works, Baldwinsville, N. Y. Ask for Bulletin No. 152.